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### SOME HISTORIC BRITISH BRIDGES.

[Editorial Correspondence.]

The names of Telford and Stephenson are well nigh as familiar to American engineers as to English engineers. At the little city of Conway, on the coast of North Wales, there stand side by side two bridges, one built by Telford, the other by Robert Stephenson, which are of great interest to engineers.

The bridges would be notable, if for no other reason than for their wonderfully picturesque site. As shown in the accompanying view they cross the Conway River directly under the shadow of Conway Castle's gray turrets. The railway through the Tubular bridge runs close beside the castle walls on the south, while the highway which crosses by the suspension bridge was cut for 175 ft. through the northern side of the solid rock promontory on which the castle is built.

The suspension bridge was begun by Thomas Telford in 1822 and was completed in 1826. Precious few bridges of metal construction can boast of a greater age. Its clear span is 326 ft. and its width 32 ft., giving room for a roadway and one sidewalk.

Turning to the structural details, it will be seen by the photograph that the bridge is supported by four chains of eye-bars on each side, or eight in all. These eye-bar chains are placed vertically, one above another. They are not connected by any diagonal bracing, but very light vertical rods, too small to show in the photograph, connect one chain to the next above or below, and cause the chains to deflect together. The eye-bars of which these chains are made up are 9 ft. long, 3½ ins. wide and 1 in. thick, which seems very small to our present-day ideas. One can imagine, however, that the primitive iron works of 1822 may have had their resources taxed to forge these eye-bars.

The successive eye-bars of the chain are not directly connected to each other, but separate junction pieces about a foot long and six inches wide are inserted at each panel point.

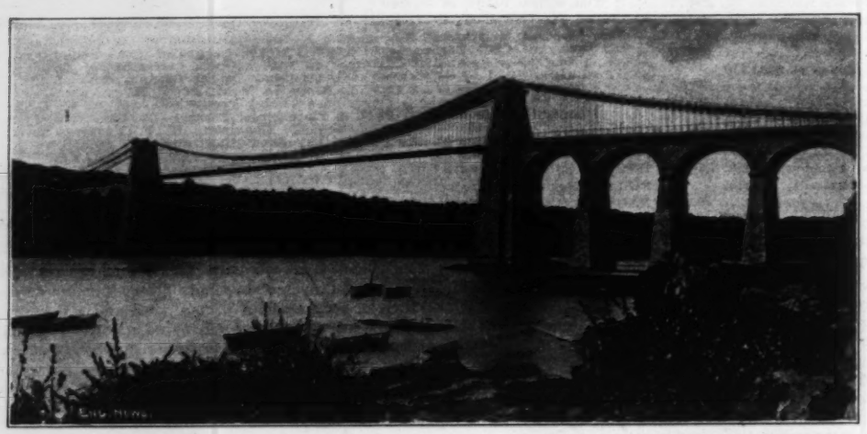
The stiffening truss is astonishingly light—so light that the stiffness of the bridge is probably due more to the great weight of the eye-bar chains and the friction of the pins to resist movement than to the stiffening truss. The suspender rods are very closely spaced, and are round iron bars.

It is to be particularly noted that the photograph here reproduced is an old one and shows the bridge as it was originally constructed. Since this photograph was taken, four wire cables, two on each side of the bridge, have been added and are placed above the eye-bar chains and spaced the same distance above them that the eye-bars are apart. Each one of these cables is made up of nine 2-in. wire ropes, not twisted together but assembled by clamps into

SUSPENSION AND TUBULAR BRIDGES OVER THE CONWAY RIVER BESIDE CONWAY CASTLE, NORTH WALES.

circular form. These cables are thus about the same diameter as the width of the eye-bars, and being spaced equally from them, as just noted, look like part of the original structure. At a little distance, one not observing closely would assume the suspending members to be five chains of eye-bars instead of four.

The bridge is located over salt water in a land of frequent fogs and rain, and it is not surprising to learn, therefore, that during the 78 years which it has stood practically the whole of the original structure has been renewed with the exception of the eye-bar chains and of course the masonry towers.



THE SUSPENSION BRIDGE OVER THE MENAI STRAITS, FROM THE ISLAND OF ANGLESEA.

The guide book says, with English precision, that the structure cost £58,004, 11s. 5d. It may seem a huge sum to pay for spanning an opening 326 ft. across with a highway bridge, yet when one considers the limited resources of that day—evidence of which is the four years required to build the bridge, there is reason for surprise that the cost was no greater.

It is worth noting that Nature provided the anchorages. At the western end the chains are secured in the solid rock on which the castle is built. At the opposite end a small rocky island in the Conway estuary served at once as foundation for the tower and anchorage for the chains. An embankment was made across the shallow water to the east of this island to carry the roadway to the main land.

And now a word as to the larger work of which this bridge formed a part, and also as to another much greater bridge due to the same engineer:

Previous to 1826, the through mail route from London to Holyhead (the western extremity of Anglesea), was interrupted by ferries across the Conway estuary and the Menai strait, the latter separating the Island of Anglesea from the mainland. Passage across the Conway—again according to the local guide book—was by "an awkward kind of boat called yrysgraff." If the boat resembled its name it is not strange a bridge was desired.

During the building of the Conway bridge, Telford was also building the longer span bridge across the Menai Straits, a photograph of which is reproduced herewith. This structure has a clear span of 580 ft. between piers, and is 1,000 ft. in total length. It is supported by 16 chains of eye-bars, having a total length of 1,735 ft. The roadway is 100 ft. above high water level. Although completed over 80 years ago, this is still the longest span suspension bridge in Great Britain.

The route from London to Holyhead was then, as it is now, the shortest and quickest route between London and Ireland. The regular time for the mail coaches from London to Holyhead, a distance of 260 miles, was 41 hours. Telford was called in to advise as to what could be done to shorten the time of transit. The Conway guide book is again my authority for the statement that:

> By insisting on the importance of a solid bed formed of hand-laid stones of small size, of efficient drainage, of a convex surface, and of prompt repairs of imperfections, Telford was able so greatly to improve the route on which his services had been requisitioned that the journey of 260 miles, which had previously taken 41 hours to accomplish, could be regularly performed in 27, and he had the satisfaction of knowing that the Holyhead mail had become in his lifetime the fastest coach out of London, maintaining what was then considered the extraordinary speed of ten miles and a quarter an hour, exclusive of stoppages.

In a later letter I shall have more to say concerning these English roads; but it is worth noting that the rate of speed referred to above is just about the same that was attained at about the same time by the coaches between Baltimore and Washington, as described in the reminiscences of Randolph B. Latimer, published in Engineering News of July 23, 1908.

But ten-mile-an-hour coaches were rendered obsolete within four years from the time the bridge across the Conway and the one across the Menai Strait were completed, by an event which happened in the same locality, barely fifty miles away. That event was the steam locomotive trials on the newly completed Liverpool & Manchester Ry., when George Stephenson's famous "Rocket" carried off the prize.

Twenty years after Telford completed the suspension bridge over the Conway, the Chester & Holyhead Railway was under construction and the problem of crossing the Conway and the Menai Straits again arose. The art of bridge design had made no great advances in that period. The unsuitability of suspension bridges for the concentrated loads of railway traffic was obvious. Not only was the application of stiffening trusses to them not yet understood—witness the slender lattice work of the Conway bridge—but the art of truss-bridge construction was still in the early infancy of development. Long spans were a necessity, both at Conway and at the Straits, because of the [illegible] depth of water, the high tides and rapid cur[illegible]. The art of founding structures in deep wa[illegible]y the aid of the pneumatic process was not [illegible]orn.

It was under these circumstances [illegible] Stephenson came forward with the [illegible]osition to build a tubular bridge of 400 ft. [illegible] span across the Conway. At the present [illegible] with the knowledge accumulated during t[illegible]nera-tions' experience in metal truss and [illegible] con-struction, the tubular bridge appears [illegible]thing of a monstrosity—a ponderous and [illegible]nsive way to do a simple thing. The guide [illegible] says, however, that "the Tubular bridge [illegible] the Conway is one of the greatest scientific achievements of the age and truly a marvelous triumph of engineering skill," and I am inclined to think the guide book is right.

If we call the tubular bridge a plate girder structure, I am sure that the engineer of the present day who built a plate girder bridge of 400 ft. clear span would be considered to have performed an important work. What shall we say, then, of the task of building such a bridge with only such too'ls and materials and men and above all such knowledge of stresses as was available to the engineering profession sixty years ago?

But the tubular bridge is a more intricate structure to design than a plate girder. The floor and roof of the tube form the bottom and top chords of the girders, and it will be seen, therefore, that the two sides of the tubes which may be considered as girders have their chords all on one side. To carry the enormous stresses from the chords to the webs, under these conditions, with the girder having a clear span of 400 ft. and an extreme depth of 25 ft. 6 ins. would make most bridge engineers scratch their heads, even to-day.

How these problems were actually solved, I have no present knowledge. The details were fully recorded, without doubt, in the engineering literature of that day. I will only note here that the guide book says:

> The strength of the tubes is dependent chiefly on the peculiar construction of their roofs and bases, which are cellular. The cells in the roof of each tube are eight in number and run longitudinally, while of those below, being larger, there are only six.

Each tube is 412 ft. long and rests on the masonry pier for 6 ft. at each end, having therefore a clear span of 400 ft. Each tube is 14 ft. wide and 22 ft. 6 ins. deep at the ends, increasing to 25 ft. 6 ins. at the center.

THE BRITANNIA TUBULAR BRIDGE OVER THE MENAI STRAITS.

It was impossible to build the structure in place on falsework. It was, therefore, erected on the banks of the river and floated into position on pontoons when completed. The weight of each tube is 1,300 tons (English long tons, of course). The guide book states that the deflection of the tube under its own dead weight

had been calculated by Stephenson to be 7 ins. and proved to be actually 7⅞ ins.

Then came the testing of the tube by the application of a load. While still on its false-work the tube was wedged up on bearings at each end and a load of 300 tons was applied at the center. The added deflection due to this load was only 2⅜ ins., and all but a quarter of an inch of this was recovered when the load was removed.

The final task of floating the first tube into position and placing it on its piers was carried out on March 11, 1848, under the personal superintendence of Robert Stephenson and his venerable father, George Stephenson. Is it not noteworthy, too, that the guide book from which I am quoting not only gives full credit to the illustrious engineers who designed the bridge but mentions also that

> Among those who were conspicuous in conducting and assisting the operation [of floating the span into place] were Mr. Brunel, Mr. Rendell, Mr. Clarke, Mr. Ross, Mr. Hodder, Mr. Forster, Mr. Fairbairn, Mr. Evans, Capt. Moorsom, and the crew of the "Great Britain," commanded by Capt. Claxton.

The names of Brunel and Fairbairn will be at once recognized as probably the men who later became famous for their professional work.

Not only does this guide book thus give credit to the engineers who bore a comparatively modest part in this work; but it records the public banquet given to Robert Stephenson at Conway a month following the day when the first locomotive passed over the bridge, and the following bit is surely worth record here:

> In responding to the toast of the evening, the illustrious engineer said that when he first mooted before a Parliamentary Committee the notion of a tubular bridge of wrought-iron plates, an incredulous glance of the most marked and unmistakable character was turned on him from every honorable member. The glance he did not forget, but it did not weaken his conviction, for he saw the practicability of the plan, and stuck to it.

And now how does a tubular bridge, built of wrought-iron plates sixty years ago, and in use under the trains and locomotives of the present day, strike American bridge engineers? The Victoria Tubular bridge over the St. Lawrence at Montreal was built a considerable time after these Welsh bridges. When it was replaced by a modern truss bridge ten years ago, it had become a most serious menace to the safety of trains. The gravest defect of the tubular bridge, as we now know, is the very rapid corrosion due to the locomotive gases and steam, confined in the tube as they necessarily are. What engineer is wise enough to say when the corrosion on the inside of such a tube crosses the line of safety? Or rather—since the line of safety is not a line but an area, as safety is always a comparative term—what engineer is wise enough to determine the margin of safety that still remains in a badly corroded girder—particularly when the girder is so intricate in construction and difficult of inspection as the tubular bridge necessarily must be?

Here let me record the unique method which has been adopted at Conway for strengthening the tube. I have seen weak girders helped out by a temporary pier under the center. At Conway, since the time when the photograph above reproduced was taken, the tubular bridge has been strengthened by shortening the span. In front of each of the old piers and at a little distance from it a cylinder pier has been put down and now forms the support for the tube at each end, shortening the clear span, I should judge, to about 300 ft.

So far as I am aware, however, the much longer bridge over the Menai Straits, built by Stephenson immediately after the Conway bridge, remains as originally constructed. This structure is truly noteworthy among the great bridges of the world. The two main spans are 460 ft. long in the clear between piers, the two side spans are each 260 ft., and the total length of the bridge and approaches is 1,840 ft. The central pier rests on a rocky islet known as the Britannia Rock, from which the bridge was named. This tower has a height of 230 ft. The railway track is 104 ft. above the water. The weight of each tube of the central spans is 1,600 tons, and the task of floating these great girders into position and placing them on piers at such a height above the water was surely a bold undertaking.

Is this great bridge and the smaller bridge over the Conway safe for trains after their sixty years of life? Certainly this question must present itself to every engineer who knows the condition of the Victoria Bridge when it was taken down. It may be remarked that these bridges are on the London & Northwestern Ry., which stands among English railways about as the Pennsylvania does in the United States. It may well be thought that the engineers of this great and wealthy system are not running undue risks. They have had full warning, certainly, of the dire effect of locomotive gases, through the fall of the roof over the trainshed in one of the great London stations a few years ago.

It must be said, too, that a considerably longer life might be expected for these tubular bridges in Wales than the Victoria Bridge at Montreal had. The Victoria Bridge was very much longer, thus giving less opportunity for clearing the locomotive smoke away by natural ventilation. Further, British locomotives, notwithstanding the soft coal they burn, make on the average I should judge not over one-tenth the smoke of American locomotives.

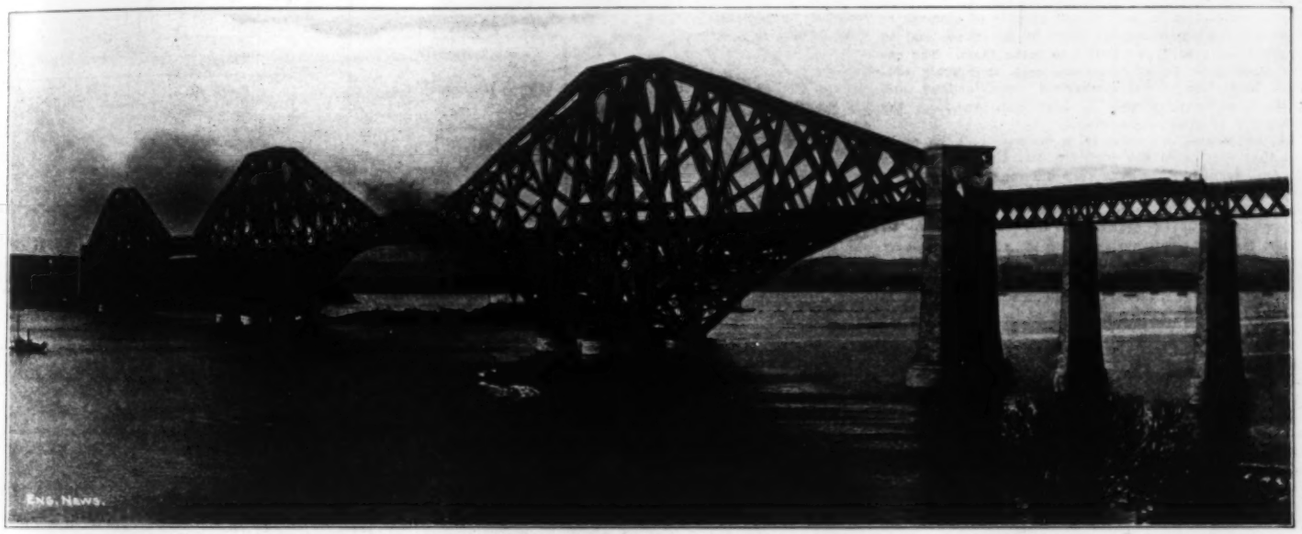
It is truly marvelous how little smoke and cinders are thrown from the stacks of these busy little British engines. I have seen one big switching engine in St. Louis burning the soft Illinois coal make more smoke than a whole yard full of these engines here. How it is done I do not know, but I can guess that brick arches, large grate areas and more than all else intelligent firing are the principal factors.

At any rate the delightful result is that traveling on British railways is quite as clean as on Phebe Snow's far-famed "Road of Anthracite."

Perhaps it may be suggested that the corrosive factor in locomotive gases lies not in the soot but in invisible sulphur dioxide, yet the soot doubtless acts like a blanket to hold the sulphurous acid against the metal and help eat it up.

At any rate, there the tubular bridges stand. Their exterior is kept painted and protected in most perfect fashion and one can only wonder what is going on inside and how long they will endure.

The bridge which every engineer, or at least every bridge engineer who visits Great Britain will wish to see, is that over the Firth of Forth, seven miles north of Edinburgh, which still ranks as the greatest bridge in the world, and will always rank as one of the most stupendous achievements in the engineering world. Its design is to a degree quite as unprecedented as the design of Stephenson's tubular bridges and it is probably as little likely to be copied. Yet no one can view it without deep respect for the master minds that conceived it and carried it through long years of laborious construction to final completion.




THE CANTILEVER BRIDGE OVER THE FIRTH OF FORTH; CHANNEL SPANS, 1,700 FT.

I may take space to note here only one small detail—perhaps not so small after all—the care taken in the design of the bridge floor and the heavy parapets that a derailed train shall neither strike the bridge trusses or go over the side of the bridge to the same destruction that befell the train on the Tory bridge years ago. But this is of a piece with British practice elsewhere on high bridges and viaducts. Compared with it our American way of sending a train at 60 miles an hour across yawning chasms with nothing but the track rails to guard it from destruction is at least a contrast. And derailments are less frequent with British rolling stock than with American.

C. W. B.

Edinburgh, Aug. 22, 1908.

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**REINFORCED-CONCRETE BOATS, similar to those now in use in Italy, which were described in this journal, April 23, 1908, p. 453, are to be manufactured for use on the Missouri River by the Moechel & Lowther Engineering Co., of Kansas City, Mo. This firm has made models of a 300-ton power boat in 1-60th size and of a 300-ton barge in 1-45th size, each to draw 3¼ ft. of water in the full size boat. Tests made on the models show very favorable results, but as yet the 300-ton vessels have not been built.**

## STANDARD BOILER-HOUSE DESIGN OF THE OLIVER IRON MINING CO.*

By A. M. GOW.†

Before considering in detail the plans of the standard boiler-house of the Oliver Iron Mining Co., the conditions which it was designed to meet should be understood. In advance it was seen that a large number of boiler-houses would have to be erected and to avoid the labor and expense involved in a multiplicity of design it was important that some standard plan be adopted that would lend itself to the variety of conditions to be encountered at the various mines. In other words, while it was necessary to adopt a standard, the standard must have a great degree of elasticity and adaptability. The word "standard" as used in this connection does not mean "duplicate"; each separate installation presents its own peculiar conditions of location and size that must be taken into consideration, but certain features of construction and practically all matters of mechanical detail have been so standardized that the design of a new boiler house consists largely in assembling plans that have already been worked out. To begin with, it was necessary that the building should be such that it could be readily erected by available labor and be reasonably free from danger from fire. The boiler should be suitable for 150 lbs. working pressure and of a type, which in the judgment of the Chief Engineer, was least liable to give trouble and could be maintained at least expense, while maintaining maximum efficiency. The setting should be adapted for use with from two to six boilers in battery and capable of increase or decrease; the appurtenances must be as simple and as nearly "fool proof" as possible to make them. The entire plant must be of reasonable cost, thoroughly efficient and free from mechanical complications and "frills," while fully able to bear criticism from the standpoint of good engineering.

At the outset, therefore, it is evident that the problem that confronted the engineer, Mr. H. J. Wessinger, M. Am. Soc. M. E., was a very different one from that which presents itself when a central power station of 5,000 to 20,000 HP. is to be designed, with a lease of life supposed to be everlasting and the whole to be under the immediate supervision of a chief engineer with an abundance of skilled labor. The boiler house of the Oliver Iron Mining Co. is not to be judged by the standards applicable to such installations. It is essentially and primarily a boiler house adapted to the needs of the company. How well the plans have met the requirements may be judged from the fact that within the last six years about 30 boiler houses have been built, containing from two to six boilers each, and no essential changes made in the general designs.

This same system of standardizing working plans has also been followed in the design of dry houses, oil houses, office and warehouse buildings, captain's offices, small machine shops and engine houses. In all these buildings a certain type of construction is followed, the details remaining the same, so that the work of designing a new building consists largely in assembling existing plans, already worked out, and adapting them to the new location.

THE BOILER.—The standard boiler is a 72-in. × 18-ft., horizontal tubular, with ½-in. shell, 9/16-in. heads, designed for 150 lbs. working pressure. The specifications are practically those of the Hartford Steam Boiler & Inspection Co. somewhat condensed. The exact length over all is 17 ft. 11½ ins., that 18-ft. tubes may be used. The tubes are 4-in. Shelby steel, spaced wide in the center and away from the sides. A manhole is provided in the front head and four 1½-in. through-rods, upset at the front end and secured by inside and outside nuts, stay the heads below the tubes. The longitudinal seam is double butt-strap, quadruple riveted, having an efficiency of 94%. Upon the boiler are located three cast-iron nozzles, faced and drilled for 1902 standard flanges; one 4-in. for feed and auxiliary steam connection; one 7-in. for main steam connection, and one 4-in. for safety valve. The blow-off connection is a pressed steel flange threaded for 3-in. pipe. Special attention was paid to the matter of bracing the heads and 22 braces were provided, carefully spaced, no brace less than 3 ft. 6 ins. long or less than 1 in. in cross section. Approximately 100 boilers have been built to these plans and specifications and no reason found to alter any of the details. The boiler is shown in Fig. 1.

The question has often been asked why this type of boiler was adopted and not some approved type of water-tube. It is not within the province of this paper to discuss the relative merits of different types of boilers. Suffice it to say that it will not be admitted that, necessarily, a water-tube boiler is a more economical steam generator than a horizontal tubular. The horizontal tubular can be set, removed and re-installed with much greater ease and economy than can a water tube, and this matter of removal is here an important one, considering the life of the plants. Comparatively speaking, the installations are small, rarely exceeding four boilers to a battery and the matter of ground space is not one of serious moment. The objections raised to this type of boiler by the water tube advocates are the difficulty of cleaning, the liability to bagging and the danger from explosion. The water at the mines of the company is almost uniformly good; with good water and reasonable attention tubular boilers can be and are kept clean. As to bagging, the records show that with the hundreds of tubular boilers in use by this company, about one boiler in 100, per year, bags. Serious bags, which cannot be driven back and require either a new sheet or patch have amounted to less than one boiler in 200, per year. As to the danger from explosion, it will not be contended that this does not exist. Boiler explosions do occur and in the most unaccountable manner. By constant and careful inspection it is hoped to reduce this danger to a minimum. But the results from burst tubes in water tube boilers have been very serious according to the records of the insurance companies, which records do not show, by any means, that their losses are confined to horizontal tubular boilers.

THE BOILER SETTING.—The setting is shown in Fig. 2. Regardless of the number of boilers in a battery this drawing is followed. It has been repeatedly used for batteries of from two to six. The boiler is supported upon lugs and is not suspended. This feature has been severely criticised, for as a rule, an advocate of the suspended setting can see no merit whatsoever in the supported setting. A first-class, suspended setting is, no doubt, superior to a poor, supported setting, but it will not be admitted that there is anything inherently wrong in supporting a boiler by lugs, resting upon the side walls. The claim that the walls of a suspended setting are less liable to crack and bulge than those of a supported setting is not borne out by experience. Walls that are heavy enough to reduce radiation to a minimum are abundantly strong to bear the weight of a boiler. Lighter walls are not desirable. Having provided heavy walls for the purpose of retaining the heat there is no reason why they should not serve the additional purpose of carrying weight. The advocates of the suspended setting place great stress upon the idea that it is almost impossible to make the four lugs bear equally and, as a consequence, unknown and torsional strains are introduced. There is some truth in this contention, but admitting that the weight on each lug is not equal it remains to be proven that the strains thus introduced are of any material consequence. The boiler is sufficiently strong to bear such torsional strains even if supported upon but two diagonally opposite lugs. The suspended setting does not lend itself readily to increase or decrease in the number of boilers in the battery and this is an important consideration with the company. Take it all in all, the introduction of columns into the side walls and overhead supporting beams involves elements of cost and inconvenience which are wholly unnecessary and do not give adequate returns.

It will be observed that the distance from the grate bars to the boiler shell is 36 ins., that the bridge wall is low and merely serves to prevent fuel being pushed off the grates, and that there is no filling back of the bridge wall. It is not desirable that the flame should "hug" the boiler. The effect of the relatively cold boiler shell is to retard combustion and what is desired beneath the boiler is the most complete combustion obtainable. The heating surface of the shell is 11% of the total heating surface. It is in the tubes that the heat must be absorbed and not through the shell. Combustion must be complete before the gases enter the tubes. Complete combustion is furthered by a large combustion chamber, a low bridge wall and considerable distance between the grates and the shell. Rather than contract these dimensions it would be preferable to increase them.

The side walls are made heavy not with the expectation that all cracks may be avoided but that the loss of heat from radiation may be reduced to a minimum. The air space in the walls, to a limited extent, allows the inner wall to expand independently of the outer wall. But a certain amount of cracking of the outer wall is to be expected; if the cracks are kept pointed, so that no air is drawn in, no harm is done.

In place of putting a single course of brick over the shell the masonry is leveled off to the top of the side walls, making the top of the battery as smooth as a ball room floor. This floor can then be kept clean and free from the rubbish that is so prone to accumulate on the top of boilers. The fire hazard is materially reduced thereby. In addition, when the fireman has occasion to go there he does not fall over loose planks. Valves and manholes are accessible. Furthermore, this mass of brick work reduces heat losses. As a matter of fact it is never uncomfortably hot on boilers set in this manner. It is not advisable that a space should be left between this brick covering and the boiler. In fact such a space is decidedly objectionable, so the first course is laid immediately against the shell, thus effectually preventing the short circuiting of the gases with the consequent corrosion of the shell. The bottom of the ashpit is finished water-tight with cement below the level of the floor, and firemen are instructed to keep water therein. The evaporation serves to keep the grate bars cool. The use of live steam beneath the bars is considered as extremely wasteful and wholly unnecessary.

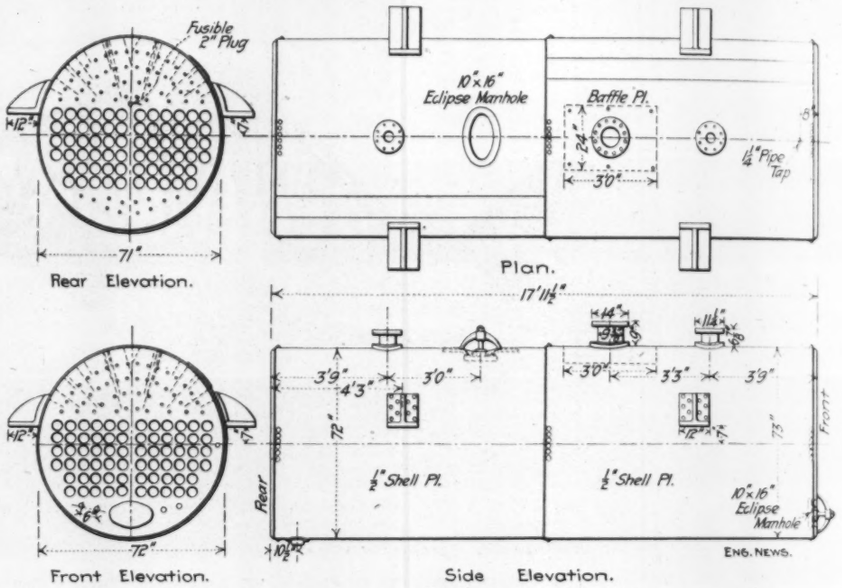



FIG. 1. BOILER USED IN STANDARD BOILER-HOUSE DESIGN OF THE OLIVER IRON MINING CO., DULUTH, MINN.

The boiler is set level. This is in direct opposition to the general practice of setting boilers high in front. The reason for setting level is that the flanges may come horizontal and taper joints be avoided. The only argument in favor of setting high in front is that scale and mud may drain to the rear. But the advocates of this practice ask for only 1 or 1½ ins. in 18 ft. It is not supposable that a slope of about 1/16 in. per ft. especially when the rear sheet makes a dam ½ in. high at the center, can, to any appreciable extent, effect the currents of circulation along the shell. It is well known that the circulation establishes a current along the bottom of the boiler from the rear head forward. This frequently results in a deposit of mud and scale at the point where the heat is most intense, just forward of the bridge wall. That this current can be reversed and caused to flow in the opposite direction by so slight an inclination as 1/16 in. per ft. is not reasonable. Owing to the expansion and contraction of the firebrick in the furnace there is a slight tendency for a boiler to settle in front. That the boiler may eventually rest level there is no objection to a slight elevation at the start; but the idea that a boiler should be set high in front that scale and mud shall wash to the rear is believed to be erroneous and not borne out by experience. Even if it were so, the area that is

*A paper presented at the Annual Meeting of the Lake Superior Mining Institute, Minnesota Ranges, June 24-27, 1908.

†Wolvin Bldg., Duluth, Minn.

effected when the blow off is opened must be a very limited one. Only the mud in the immediate vicinity is removed. Blowing off is necessary that the blow-off pipe be kept open and also that a change may be effected in the water; but it is not and cannot be a substitute for cleaning, however high the boiler be set in front. The way to prevent bagging is by keeping the boiler clean and is not believed that this end is in the least hindered by setting the boiler level.

There are no air passages in the bridge wall; no attempt is made to pre-heat air before combustion; there is no "secondary air supply" to the combustion chamber. These are purposely omitted, because, while they are very pretty points to talk about it is not believed that they are of any practical utility. The question of the use of automatic stokers, shaking grates,

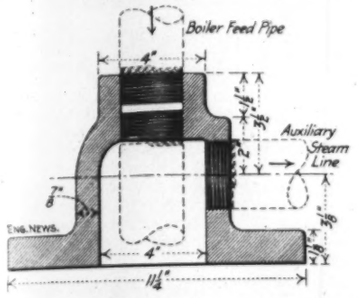



Fig. 3. Cross-Section of Boiler Feed-Nozzle Connection.

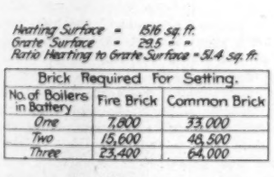
and patented furnaces, has received due and careful consideration, but despite the claims of sales agents and reports of tests, with all of which the engineering department is very familiar, that department remains to be convinced that any economy, at all commensurate with the cost, would be secured by their adoption. It would have been an easy matter to complicate this setting; the attempt has been made to simplify it. The drawing has been used to set about 150 boilers and no reason has been found for changing it.

THE FRONTS AND APPURTENANCES.—The fronts are of the full flush type and considerably heavier than those usually furnished by manufacturers. Door joints are not planed but castings must be smooth and true. Grate bars are of the type known as the Kelly bar. They present the largest possible proportion of air space to surface. Two blow-off valves are provided; a 3-in. asbestos packed plug cock and a 2½-in. brass angle valve. It is occasionally necessary to renew the brass seat, but between the two valves no trouble is experienced from leaking at the blow-off. The feed connection is somewhat novel; upon the front 4-in. nozzle is mounted the casting shown in Fig. 3. The 2-in. feed line enters the top of this casting; a 2-in. nipple is screwed in from the underside and connects by an ell to a 2-in. pipe that runs immediately over the tubes to within 2 ft. of the rear head; a tee is placed on the end of this line that the feed water may be projected towards the sides of the boiler and not against the back head. This casting is tapped at the side for a 2-in. pipe to supply steam to an auxiliary 4-in line that furnishes steam to the pump and injector. This feature of an auxiliary steam line, independent of the main steam header, is a valuable one in mining practice in that it permits of repairs to the header without cutting off the steam to the mine pumps. The steam line leading to the shaft, in addition to being connected to the header, is always connected to this auxiliary 4-in. line. This arrangement of taking steam from the same connection that admits the feed water has been objected to on the grounds that the feed water has a tendency to cool the steam thus insuring a supply of wet steam to the pump. The objection is not well taken. The condensing, or cooling effect of the few inches of pipe exposed cannot be but insignificant. Furthermore the steam to a feed pump is always throttled. The arrangement is a most convenient one and the feed pipe is much more accessible than if it entered the front head after the usual custom. To tap a feed pipe into the shell is not considered good practice as the breaking off of pipes so placed bears abundant testimony. The desirability of feeding at the blow off will not be discussed here. We are not open to conviction on that point. The combination of feed and auxiliary steam line from one nozzle has proved very satisfactory.

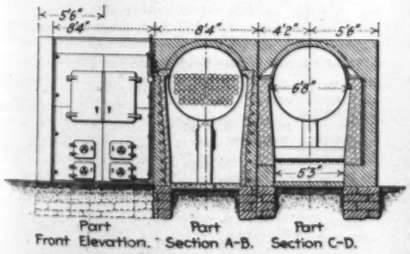
The auxiliary steam line supplies the feed pump and injector which discharge into opposite ends of a cast-iron manifold, having as many openings as there are boilers in the battery. The feed is regulated at the manifold and not at the boiler; but, in addition to the feed valve at the manifold, a 2-in. angle valve, for emergency, is placed on each boiler and the check valve located adjacent to it. This check is made flanged on one end so that it cannot be set to open the wrong way.

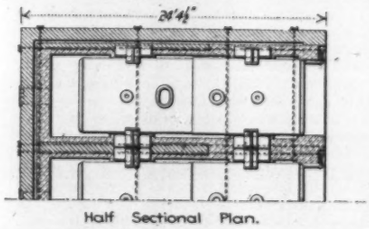
The feed water heater is of the open type and the large majority of those in use are of the Webster type. The only objection that can be raised to the open heater is the danger of getting oil into the boilers. The oil separator must be cleaned and care taken that the heater does not become foul. In none of the cases of bagged boilers was there evidence that the trouble arose from oil. Troubles from leaking tubes and deterioration of closed heaters are considered more serious than the dangers due to oil incident to open heaters.

It is the practice of the company to heat the mine buildings by the vacuum system, using exhaust steam. This effects an enormous economy in fuel. At many of the mines the power can be considered as costing nothing, for the buildings, if heated in the usual manner, would require as much fuel as, with the vacuum system, serves to supply both heat and power. The use of the vacuum system calls for a back pressure valve that shall release at a miximum of 2 lbs. and at the same time prevent the inleak of air when the flow line is under vacuum. There are on the market a number of back-pressure valves which will, presumably, answer the purpose fairly well with engines having a constant exhaust. But a hoisting engine has not a constant exhaust. At the beginning of a trip it may exhaust at 60 lbs. and after a few revolutions at atmosphere. Under such conditions a poppet valve can do nothing but pound and it pounds itself to pieces. It




| Brick Required For Setting. | | |
|---|---|---|
| No. of Boilers in Battery | Fire Brick | Common Brick |
| One | 7,800 | 33,000 |
| Two | 15,600 | 48,500 |
| Three | 23,400 | 64,000 |



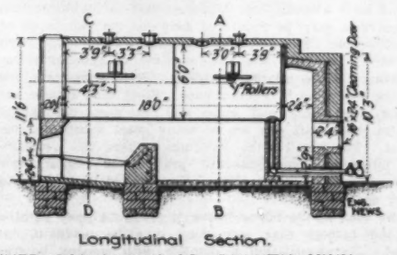
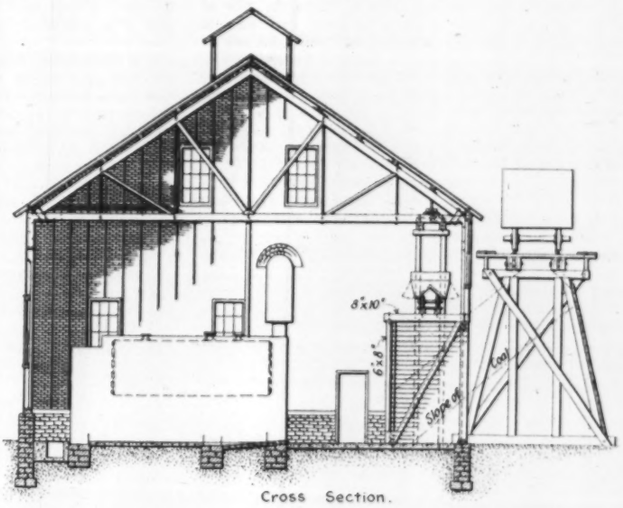




FIG. 2. STANDARD BOILER SETTING, OLIVER IRON MINING CO., DULUTH, MINN.



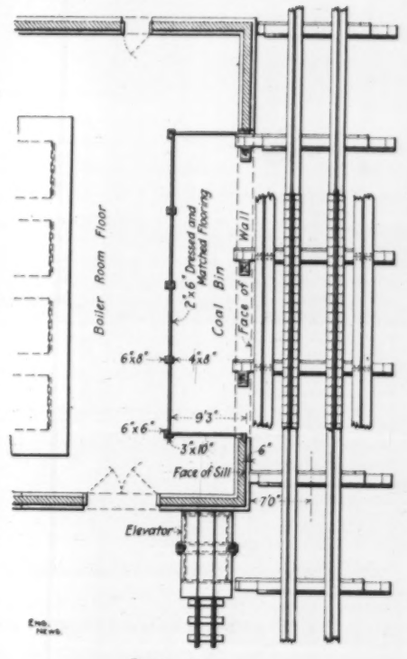




FIG. 4. STANDARD BUILDING CONSTRUCTION WITH WOOD, BRICK AND CORRUGATED IRON; BOILER HOUSES OF THE OLIVER IRON MINING CO.

became necessary to design a back-pressure valve that will not pound. The result was the Wessinger valve, that rotates on its seat after the manner of a Corliss valve. It does not pound or leak and the many in use are giving entire satisfaction. By means of a reducing tee, adjacent to the heater, a connection is always provided for the vacuum system. To supply the system and also insure a high feed water temperature a considerable quantity of exhaust steam is demanded. In a few installations it has been deemed advisable to disregard engine economy, to a certain extent, that the volume of exhaust might be sufficient to supply these demands. This is cited as an illustration of what was before mentioned, namely, that the criteria by which a large central power station might properly be judged are not applicable to the boiler houses of this company. This is in no sense an apology, merely an explanation.

With the exception of high and low water alarm on the water column, provided to conform to the state law and not because it is considered an essential, and an automatic float valve controlling the supply of water to the heater, there are no automatic appliances in the boiler room. Automatic pump governors, damper regulators, boiler skimmers and such like mechanical devices, designed to do the work of the firemen and water tenders, are not used. The question of the use of superheaters has received some consideration and may receive more. Where line condensation, as in the case of underground pumps, is considerable, there is little doubt that initial superheating would effect an economy. But

in connection with hoisting engines, where the flow of steam is intermittent, resulting in great variations of temperature in the superheating apparatus, the use of superheaters is something of a doubtful proposition.

Careful attention is given to the matter of steam pipe covering. The only insulating material used is 85% plastic magnesia. It is applied 2 ins. thick on all pipes up to 7 ins. in diameter and 3 ins. on 7-in. and over. This is expensive, but the cost is materially reduced by having men at all the mines who can do a good job of covering. With this covering properly applied no hesitation is felt in running a steam line 1,500 ft. long, with expansion joints suitably located and pipes properly drained. It is an established rule, violated only in exceptional cases, that a steam line must pitch in the direction of flow. It is not conceivable that water can flow back along the bottom of a pipe against the velocity of the steam in the other direction. For this reason, pipes pitch with the flow and to avoid water pockets it is the practice to use eccentric fittings where the diameter changes, that there may be no hindrance to the flow of condensation to the end of the line, where provision is made for trapping it off.

The size of the main header is determined by the number of boilers in battery but is always made larger than the total area of the pipes which it supplies. Thus it acts as a receiver and it is not the practice to use additional receivers on the lines. The header is connected to the boilers by curved pipes. Under no circumstances are stop valves placed next the boilers. They

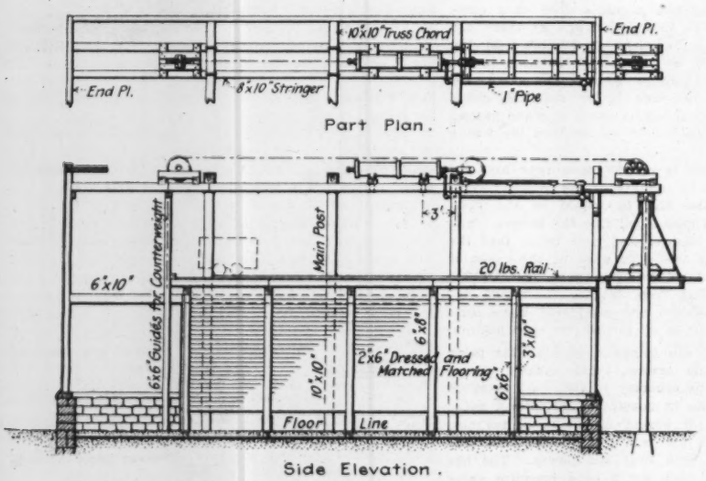



FIG. 5. ARRANGEMENT OF FIRING BINS AND COAL ELEVATOR.

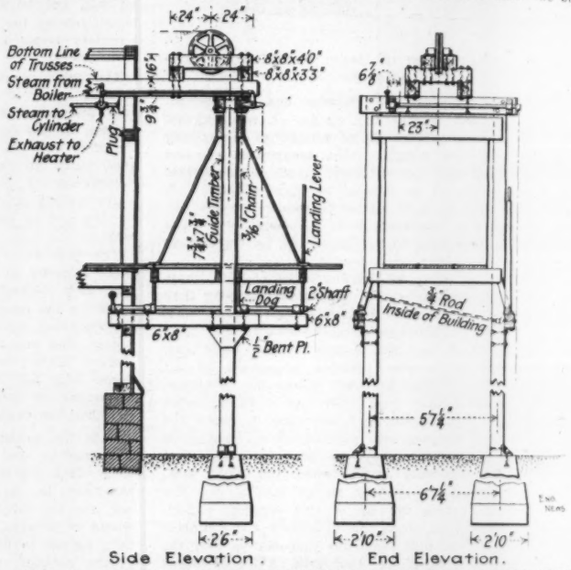



FIG. 6. DETAILS OF COAL-BUGGY ELEVATOR; OLIVER IRON MINING CO., DULUTH, MINN.

are invariably placed next the header. All valves, fittings and flanges, are extra heavy, cast iron, to the 1902 manufacturers' standard.

THE STACK AND BREECHING.—The breeching is made from No. 8 sheet steel. A damper is provided in the smoke connection from each boiler but no main damper is provided in the breeching proper. That portion of the breeching which is exposed to the weather, between the boiler house and the stack, is most likely to need renewal. Consequently this section is made so that it can be readily removed by connecting it to the remainder of the breeching by an angle iron flange located just inside the boiler room wall. Upon the question of stacks the practice has, in general, been to use brick, where a long life was anticipated, and steel where the location was on ore or where the plant was, to a degree, temporary. The permanency of the brick stack and the fact that it does not need painting, are considerations in its favor. On the other hand the first cost of a brick stack is more than that of a steel stack, made from light tank plate and guyed. But the life of such steel stacks has been in many cases surprisingly short, not over six years. The question of the desirability of the two types is now receiving careful attention from the Engineering Department. It is not impossible that some design of concrete stack may be adopted as standard, but as yet none have been built for this company. The self-contained steel stack, brick lined, "blast furnace style" as it is sometimes called, has been considered in place of the brick. It requires as much foundation as the brick stack and must be kept painted. These brick stacks are contracted, erected in place, upon foundations, all labor and material being furnished by the contractor. In two cases these stacks have been struck by lightning but the damage was not material. Recent installations have been equipped with lightning rods. Please note that there is no knob on the top. A knob does not assist the draft and its presence is a matter of taste. No quarrel will be instituted with those whose tastes differ.

THE BUILDING.—The building is shown in Fig. 4. The standard construction which has been adopted consists of a frame skeleton covered with sheeting, building paper and corrugated, galvanized iron, and veneered inside with one course of brick, between the studding. This construction is followed on nearly all the mine structures such as engine houses, dry houses, small machine shops, warehouses and captain's offices. Because of the fact that, winter or summer, buildings of this type may be erected by labor available at the mines and from material always readily obtainable, the construction has proved itself eminently adapted to the requirements. The wooden superstructure can always be framed and erected by the mine carpenters and then the work inside may be proceeded with regardless of the weather, and the corrugated iron and brick veneer put on when most convenient. The brick veneer materially reduces the fire hazard, makes the building much warmer and presents a neat and finished appearance. The brick are laid flush with the studding, so that the wall is smooth. Sheeting is laid diagonally, covered with building paper and finished with corrugated iron. The same weight of corrugated iron is used on roof and sides. It is customary to use heavier iron on the roof than the sides on most buildings but it was found that when the bundles of iron were opened the sheets were almost certain to get mixed. This is merely cited as one of the many small details that have been considered. As to the relative merits of galvanized and painted iron there is a difference of opinion among engineers. The experience of the Oliver Iron Mining Co. favors the use of the galvanized sheets and as yet the pitting of the sheets has not rendered painting necessary.

Fig. 4 shows the design of the wooden roof truss. The wooden roof truss in a boiler house has been objected to on account of the fire risk. The members of this truss are heavy and the bottom chord is always placed well above the breeching. To reduce the fire hazard to a minimum the truss is kept well whitewashed. Steel construction has been considered for such buildings and may, later, supplant the wooden standards followed up to this time. Considerations of first cost and convenience in the matter of erection, from the standpoint of both labor and material, led to its adoption. With the constantly increasing cost of timber and the constantly increasing facilities for obtaining and erecting steel structures it is possible that the design may be changed to steel construction. Plans and estimates have already been made on certain buildings that comparison may be instituted between the two types of construction. For all large buildings steel construction is used. In fact, the use of steel is constantly increasing in the mining business. Steel tram cars are taking the place of wooden ones. Steel head frames are being used more and more and on deep, permanent shafts steel shaft sets are in many cases substituted for wood. For small mine buildings, where the necessity of following some standard practice is urgent, this brick veneered construction has proved itself to be very desirable.

The roof of the boiler house is always hipped parallel to the battery that extensions may be made if desired. For ventilation a monitor with wooden louvres is provided and upon recent installations wire screen is put over the openings for the industrious [illegible] the top of a warm boiler house a suitable pl[illegible] building, using all the inflammable rubbish in [illegible] borhood.

The best way to get the coal within easy [illegible] firemen is something of a problem. Ove[illegible] filled by elevators and discharged by spout[illegible] mirable for large plants, present cost consid[illegible] of the question in plants the size of these. A[illegible] time coal storage for the winter months [illegible] necessary. The plan as adopted and in use [illegible] plants is shown on Figs. 5 and 6. A coal trestle [illegible] alongside of the boiler house and in this co[illegible] is well to remark the site of the boiler house [illegible] considered in connection with the possibility [illegible] a trestle to it at proper grade. Upon the [illegible] boiler house are built bins that discharge co[illegible] reach of the fireman's shovel. In summer t[illegible] coal is being regularly received in drop bottom [illegible] bins are kept full directly from the cars. T[illegible] supply is stored between the bents of the tr[illegible] one end of the boiler house is a coal elevat[illegible] a platform raised and lowered by means of [illegible] cylinder within the boiler house. A coal bug[illegible] been filled is run on the elevator, raised to [illegible] of the bins, run into the house and empti[illegible] into the same bins that in summer receive [illegible] direct from the cars. There is no wheeling [illegible] and dumping it on the floor. Having filled the [illegible] laborers are available for work elsewhere until the bins need to be filled again. The records of cost show a notable saving per ton by this method of coal handling.

finds [illegible] nest [illegible] neigh- [illegible] of the bins, [illegible] ad- [illegible] s out [illegible] same [illegible] lutely [illegible] ll new [illegible] erected [illegible] ion it [illegible] usually [illegible] retting [illegible] of the [illegible] within [illegible] when [illegible], the winter [illegible]. At [illegible] simply [illegible] steam [illegible] having [illegible] level [illegible] rectly [illegible] coal [illegible] the

At the back of the boilers is provided a trench, covered with cast-iron plates, to receive the blow-off pipe and exhaust pipes leading to the heater. It is considered very bad practice to locate the blow-off pipe underground, or where it is not accessible. Furthermore the end of it should be visible. Steam and water coming from this pipe is the surest indication of leaking blowoff valves.

Where the battery consists of but two or three boilers the engine room is, usually, built as part of the same building that houses the boilers, the two being separated by a brick partition wall. On larger plans the engine house is a separate building, of the same general construction that has been described.

COSTS.—A boiler plant, built to these designs, containing four boilers, brick stack, coal hoist, and everything complete, ready to raise steam, costs about $20,000. This does not include the coal trestle. From the estimates and actual costs on several installations the following cost sheet is made. It is assumed that the location is such that convenient delivery of material can be made by rail; both labor and material are higher than they were a few years ago, when the same installation could have been made for $19,000.

| | |
|---|---|
| Excavations | $250.00 |
| Foundations | 2,200.00 |
| Building | 3,200.00 |
| Boilers, grates, fittings | 4,700.00 |
| Setting, complete | 3,000.00 |
| Chimney | 3,200.00 |
| Pump, injector, heater | 1,000.00 |
| Piping and valves | 1,800.00 |
| Pipe covering | 350.00 |
| Coal hoist and car | 700.00 |
| Total | $20,400.00 |
| Water tank, erected | 700.00 |
| | $21,100.00 |

## AN AIR-OPERATED SPREADER CAR FOR RAILWAY AND OTHER WORK.

Spreading cars for leveling and spreading material delivered from cars are very extensively used in railway construction and improvement, and in similar work. Several such cars are in use on the Panama Canal works for spreading the material at the dumps. Others are used at large coal plants for spreading coke, broken stone, etc., on the stock piles. The accompanying cuts illustrate a spreader car built recently by the O. F. Jordan Co., of Chicago. A Jordan spreader was described in our issue of Jan. 4, 1906, but the new machine has four important features: (1) the application of compressed air to effect all the various movements; (2) the use of a front plow to clear material from the track in advance of the machine; (3) the means of adjusting the wing braces; (4) the availability of the machine as a snow plow or flanger during the winter, when an ordinary spreader car would have to be left idle.

FIGS. 1 AND 2. AIR-OPERATED SPREADER CAR WITH FRONT PLOW FOR RAILWAY WORK.

A side view of the machine is shown in Fig. 1. It is a steel-frame flat car, 6 ft. wide, carrying all the several devices and the operating mechanism. A cylindrical receiver is kept charged with air at about 70 to 80 lbs. pressure by the brake pump on the locomotive attached to the car. Behind the receiver is a tool box.

One of the special features is the equipment for clearing material off the track in front of the machine, in addition to spreading material standing beside the track. At the middle of the front of the car is a wing plow, pivoted so that it can be set diagonally across the track in either direction from the center. An inclined plate in the form of the snow plow on a locomotive pilot is attached to the front of the car, just behind the wing plow, and throws the material clear of the track. An apron plate extending below the end sill prevents material from falling behind the fixed part of the plow onto the track. The wing plow is held in either position by timber braces fitted between its rear side and a step under the corner of the end sill. The plow is raised and lowered by the vertical cylinder on the front end of the car. Its nose or forward end is supported by the diagonal member, which is made telescopic in order to admit of adjusting the position. With these attachments, the machine is adapted for use as a snow plow.

The main spreader wings are pivoted to heavy posts on either side near the middle of the car, and are raised and lowered by vertical inverted cylinders attached to the inner sides of the posts, as shown by the rear view in Fig. 2. The wings are operated independently of each other. Each is operated by a set of members which also brace it against the side of the car. These braces are able to hold the wing at any desired angle. In the earlier cars they were telescopic for adjustment as to position when horizontal, and were raised and lowered by chains attached to hand winches. The adjustment could not be made while the machine was at work, the bolts in each brace having to be taken out and replaced.

In the new car, each member is articulated, having a knuckle joint at the middle. One end has a pivot attachment to the wing, and the other end is seated in a cast steel socket. All the sockets are mounted on a heavy longitudinal square bar. The air cylinder beneath the car is connected to a lever on this bar. It thus turns the bar on its axis, and in this way raises or lowers the wing braces so as to move the wing inward or outward as required. In Fig. 2, the left wing is closed, the right wing is thrown partly outward. The knuckles of the joints in the braces are so shaped that pressure tends to make them lock together. A diagonal tie from the top of the side post supports the outer end of the wing. This tie is made telescopic, as shown. The upper part is an I-beam with holes in the web; the lower part is composed of two channels bolted on either side of the I-beam. The adjustments are easily effected. Fig. 3 is a view of the work of the spreader for filling or widening. It will spread to a maximum width or 44 ft. (or 22 ft. on each side from the center line of the track).

In front of the main wing is a small wing which closes the opening between the car and the heel of the main wing. This is shown in Fig. 1, but is folded forward against the truck in position for transportation. When in service, this is swung back so that its end bears against the main wing. It is raised and lowered by an air cylinder. A steel plate or shield outside of the truck prevents material from flowing in upon the track and blocking the wheels. This has an opening to allow for the movement of the journal box of the front axle. The opening may be closed by a flap, this being held in place only by springs, so that it could be forced outward if the box should strike it as the truck swivels on a very sharp curve.

Fig. 3. Work done by Spreader Car in Plowing Material off the Track and Spreading Material Dumped Along the Track.

The car and all its attachments are very substantially built, and all castings are of steel. The arm sockets and the large hinges and attachments of the side wings are steel castings. The trucks also have steel frames. The total weight is about 30 tons. The car is fitted with air brakes, and has an air whistle by which the operator can signal the engineman. The machine is operated by one man, who stands between the side posts. Here he has at hand the levers of the valves controlling all the movements of the main and small wings, and the front plow.

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THE LUMBER CUT OF THE UNITED STATES for 1907, according to figures compiled by the U. S. Bureau of the Census and the U. S. Forest Service, was over 40,000,000,000 ft. B. M. This includes returns from 28,850 mills, and is believed to include 95% of the actual cut. The cut for 1906, as reported by 22,398 mills, was 37,500,000,000 ft. The increase for 1907 over 1906 is 7% in cut. Although the percentage of mills reporting was greatly increased in the latter year, it is thought that this does not indicate any great deficiency in the total cut for 1906 owing to the fact that most of the mills added to the list are relatively small. The average lumber cut of the United States was increased, so far as can be told from the available figures, from 250 ft. per capita in 1850 to 480 ft. in 1907. The per capita cut for 1900 was 460 ft.

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THE RELATION OF FORESTS TO WATER SUPPLY for cities, irrigation, power and navigation is to be studied in detail by the U. S. Forest Service in cooperation with the Weather Bureau, the Reclamation Service and the Geological Survey. In order to secure immediate information on this subject, desired by the National Conservation Commission for use in its report Nov. 1, the Forest Service is sending the following questions to competent observers throughout the country who are known to be interested in this and other national problems:

(1) Have any instances come under your notice where the removal of the forest cover from a certain watershed [drainage area.—Ed.] has had any definite effect upon the flow of the streams which take their rise there, and, if so, to what extent? Please give the dates, as nearly as possible, the exact location of the watershed, and describe, as nearly as you can, the topography, the rock, the soil, and the kind of forest removed.

(2) Have you observed any relation between the condition of watersheds and the silting up of rivers, ponds, and reservoirs?

(3) Do you know of any specific instances where the destruction of the forest cover upon watersheds which furnish water for the use of towns or cities can be held responsible for the breaking out of epidemics?

(4) Do you know of any specific cases where springs have dried up after destruction of the forest cover, or where they have returned with its restoration? Please give the dates, as nearly as possible, the exact location of the spring, and describe the topography, the rock, the soil, and the character of the forest which was removed or which has sprung up again.

(5) Do you know of any instances where artesian wells have dried up, or where they have begun to flow again? Can any connection be traced between this and the condition of the catchment basin? Give the dates as nearly as possible, the location of the catchment basin, and describe the topography, rock, soil, and the general forest conditions.

(6) Can you suggest the names of any persons who would be in a position to give additional facts?

## READJUSTMENT OF CURVES AND TANGENTS IN MAINTENANCE-OF-WAY WORK.

By W. H. Wilms.*

A large majority of the civil engineers graduated every year by our large colleges and technical schools will enter railway service, and of these perhaps 75% will be employed on maintenance-of-way work. It is for this latter class of young men, now pursuing their studies or having just graduated and about to take up maintenance work, that the following notes on the realinement of curves and tangents have been prepared. They are not intended to be simply of interest to them, but to serve as a tool in their future work.

A very important item of work in maintenance-of-way consists in giving line on both curves and tangents. In the class room and field the student is taught the elements of curves and spirals, and how they are laid out in location and construction work. But the instruction in these subjects as applied to maintenance-of-way work is very limited indeed, if given at all. How often may be seen curve stakes (set by young engineers just fresh from school) clinging to the inside or outside of rail, and in some cases even jumping the rail, for the entire length of the curve. A curve would have to be in very bad line indeed to necessitate throwing the track to such an extent. To throw the track to these stakes would in many cases necessitate widening the roadbed. In not a few cases it would be practically impossible, on account of the many restrictions imposed upon existing curves by bridges, buildings and other structures close to the track. As a result, the stakes will never be used. The foreman will line up the track as best he can by sighting, and the work of the engineer corps will be lost entirely. This is no uncommon case, but an everyday occurrence. The young engineer will continue thus until he learns by sad experience that special methods must be adopted in this class of work, and that the ordinary methods of setting out curves on location or construction do not always apply in maintenance-of-way work.

Very little information on the readjustment of curves and tangents has been published in the engineering journals, and much of that has been so brief as to be of slight value to the young engineer unacquainted with this class of work. Take for instance Mr. Ives' article on curve relining, published in Engineering News, Dec. 26, 1901.† In relining long curves where the tangents cannot be produced to an intersection, and where a traverse of the curve is necessary, few curves of this class can be connected by a traverse of one or two chords, such as Mr. Ives advised. A number of them will be required in many cases, and if his method of figuring the traverse (by solution of resulting triangles) were used in such cases, it would involve a great amount of figuring.

The article in question stated that when the instrument is set up over the last turning point on the curve, and a sight taken on the P. T., it may be necessary to knock the turning point one way or the other until the calculated angle between this point and the P. T. agrees with the actual one. If an instrumentman is accurate and careful in his work and takes certain well-known precautions, no such "fudging" is necessary. It is generally where curves are long that such large errors are introduced in the work. For this class of curve the writer always runs in the curve by foresights, using a simple and unique method devised some years ago by Mr. W. R. Hillary, Engineer of Maintenance-of-Way, Pennsylvania Lines. This is referred to later.

### CURVE RELINING.

In the work of setting track centers for relining track on an operated railway there are several controlling features to be kept in mind. The first one is expense. Unnecessary throwing of track means extra cost. In curve relining, an attempt should always be made to get a curve that fits the existing track as closely as possible.

Another point to be kept in mind is accuracy. On account of the many conditions and restrictions often imposed upon existing curves, such as narrow roadbed, bridges, or the presence of buildings and other structures close to the track, this class of work must necessarily be done with more accuracy and care than is usually accorded such work on location or construction. To fit existing conditions, a curve whose degree is in fractions of a minute often has to be used. In such cases the field work must be consistent with the degree of accuracy required. If the best results are to be obtained in this class of work we must have accuracy.

For the maintenance of true line on curves, track centers should be set at least every 50 ft. For curves up to 6° or 7° no correction for 50-ft. sub-chords need be applied, if the curve is located with a 100-ft. chain and the 100-ft. points are located with the chain fully drawn out. Otherwise there is liable to be serious error. For example, a 5° 30′ curve 25 stations long and located entirely with 50-ft. chords (using radius computed by 100-ft. chord, definition $R = 50 \div \sin \frac{1}{2} D$) will have an error in closure at the P. T. of 0.70 ft. for distance and 0.55 ft. for line. This is far beyond the limits of accuracy with which this work should be done.

If the radius is computed by the unit chord of 100 ft., curves over 6° or 7° should, of course, have sub-chord corrections. Not a few instrumentmen, however, compute the radii of all curves up to 14° or 15° by the two 50-ft. chord definition ($R = 25 \div \sin \frac{1}{4} D$), and the entire curve is then run in with 50-ft. chords, using a light steel 50-ft. tap. The writer uses this method and finds that it gives excellent results. The Southern Pacific Ry. uses radii computed to 50-ft. chords exclusively; this is not only on maintenance work, but on location and construction work also.

Tables of radii computed by the 100-ft. chord definition $R = 50 \div \sin \frac{1}{2} D$ can be used very readily to give radii to the two 50-ft. chord definition $R = 25 \div \sin \frac{1}{4} D$. This is done by simply taking half the radius of a curve half as great.

Since in curve relining all instrumental errors are cumulative, too much stress cannot be laid upon the importance of correct instrument adjustments. Before attempting to reline a curve the colimation adjustment should always be tested. This adjustment is important.

### SPIRALS.

It is now the general practice on important railways to spiral all curves over 2°, and in some cases where speed limits are high, curves as low as 1° are spiraled.

There is no essential difference between any of the various transition curves so far as practical results are concerned, the only difference being in their flexibility and the ease with which they can be inserted in old track. In the following notes on curve relining the true transition curve as developed by Holbrook, Crandall and Talbot has been used. Any form of transition curve can be used, however, that allows of a definite offset at the P. C.

Where conditions will allow it, the length of the spiral should be made equal to the distance in which the superelevation is run off. A length of 60 ft. of spiral for every inch of elevation on the curve is common practice. For example, a curve having 4 ins. of elevation would have a length of spiral equal to 240 ft. This makes the length of spiral dependent both upon the degree of curve and the speed (since the superelevation is a function of both these qualities), and this is as it should be.

There are two ways in which room can be made for the spirals at the ends of the simple curve:

(1) By throwing the whole body of the curve inward for an amount equal to the spiral offset.

(2) By sharpening up the main degree of curve.

If the curve is short and the offset is not large, it will probably be best to throw the whole curve inward for the full amount of the offset. In case the curve is long, the second method should be adopted, as by this means spirals can be introduced without materially deviating from the old alinement.

To eliminate all possible chance of [illegible]or due to short backsights, when the circul[illegible]rve is run in from the end of the spiral, th[illegible]n circular curve should where possible [illegible]un in from the offsetted P. C.

To save figuring in inserting spira[illegible] maintenance-of-way work, a set of spiral [illegible]tables giving all the functions of the spira[illegible] every foot of its length and for fractional [illegible]es of curve, is most desirable. An excelle[illegible]ble of this kind, based on the Talbot spiral, [illegible] compiled by Mr. G. A. Kyle, Principal As[illegible]t Engineer of the Chicago, Milwaukee & S[illegible]l Ry. of Washington, and published in the [illegible]ineering Record" Sept. 7, 1907.

### GENERAL REMARKS.

As soon as possible after a curve is [illegible]ned it should be permanently monumented. [illegible]ron or stone monuments set well below the f[illegible]st line should be used. An old piece of rail s[illegible] ft. or 5 ft. below top of ballast makes a [illegible] good monument. Monuments should be set [illegible] only at points of circular and transition curve, but also at such points around the curve as to enable the curve to be afterward re-run by foresights.

When the curve is run in, its position with reference to the nearest mile post should be noted and entered in the notebook. For future reference, the distance and direction of the center of the curve from the center of the track at each station should be taken and entered in the notebook.

After a curve has been relined, center stakes should be set at intervals of 100 ft. or 200 ft. for a reasonable distance on both tangents, in order that the track men may line the curve to them.

If work is being done on track where trains are frequent, it is advisable in turning the tangent on the curve to reference this tangent by a stake set 200 ft. or 300 ft. from the instrument. When the instrument is again set up this reference stake can be used as a foresight. If this is done, a great deal of time will be saved, and all errors that might arise in again turning tangent (and there are many) will be eliminated.

To save time of men running back to give sights, some form of fixed track sight should be used. A cheap and efficient sight is that made by a 6-penny nail and a piece of paper. This is shown in Fig. 1.

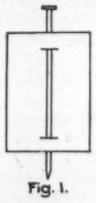

Fig. 1.

Before attempting to reline any curve a thorough search should be made for the original curve points. If these are found it is a comparatively easy matter to re-run the curve. If they are lost, the work of relining is rendered more difficult.

For the purposes of realinement work, curves may be divided into the three following classes:

(1) Short curves whose tangents can easily be produced to an intersection.

(2) Long curves where it is difficult or impossible to produce the tangents to an intersection.

(3) Very long curves.

### TO RELINE A CURVE OF CLASS 1.

(Where the tangents can easily be produced to an intersection.)

Produce the tangents to an intersection and measure intersection angle and external distance to center of track (at which point set a stake properly centered with a tack).

Figure degree of curve and tangent distance from:

$$R = \frac{E}{\text{ex sec } \frac{1}{2} \Delta}$$

$$T = E \tan \tfrac{1}{4} \Delta$$

Measure in the tangents and set P. C. and P. T. of curve.

If the line of sight is not obstructed, set the instrument over the middle point of curve (otherwise over P. C.). Sight on P. I., turn the tangent, and check on P. C. and P. T. Then run in the curve, setting at first only temporary points.

If the curve fits the track satisfactorily, stake it out, setting track centers every 50 ft. Thus, if one part of the curve comes inside and an-

*Office of the Supervisor, Pennsylvania Lines (Pittsburg division), Steubenville, Ohio.

†Other articles on relining curves will be found in Engineering News: 1902, I., 113, 134, 174, 232, 295. A method of relining tangents is described in Engineering News, 1906, II., 463.—Editor Engineering News.

other part outside the present center line of track as in Fig. 2, and if in addition the inward throw is about equal to the outward throw a new curve is not desirable. The curve fits the track in the way it should fit, and a more satisfactory curve could not be obtained.

It is often the case, however, that the curve which best fits the track will not come in the center line of the track at the center of the curve, but inside or outside of this center line. Thus in Fig. 3, though the middle point of curve is in the center of the track, the remaining portion of the curve (practically the entire curve) falls inside this center. If the track were thrown to this curve, not only would the throw be excessive, but on account of the throw being all inward, rail cutting would be necessary.

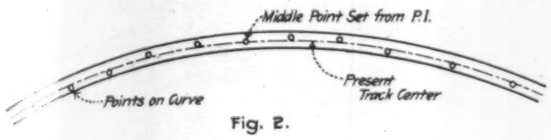

Fig. 2.

To improve this curve, the middle point should be moved outward an amount sufficient to make the throws balance. That is, to make the throw inward equal as nearly as possible the throw outward. In order to avoid a fractional degree of curve, the externals for curves one and two minutes greater should be figured and that one selected which more nearly gives the desired amount of throw at the middle point. The middle point can then be moved to correspond to this new external. The P. C. and P. T. are reset to the new tangent distance, and the curve is run in either from the middle point (which is preferable) or the P. C.

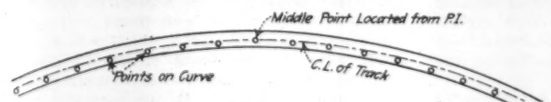

Fig. 3.

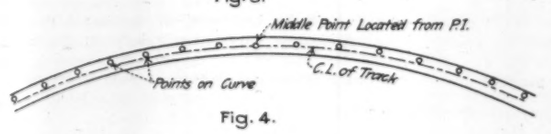

Fig. 4.

In Fig. 4 we have the same condition of affairs as in Fig. 3, except that here the throw is all outward and the middle point should be moved inward in order to decrease and balance the throw.

EXAMPLE—CLASS 1 CURVE.—From my field notes I take the following curve:

$12° 30'$ — as actually measured.
$D = 1° 30'$ — old degree of curve.
$E = 22.64$ ft. — as measured to center of track.
$E = 22.35$ ft. — external to which curve was staked.

Using the first external (22.64) the degree of curve is found to be $1° 31'$, and tangent distance, 413.75 ft.

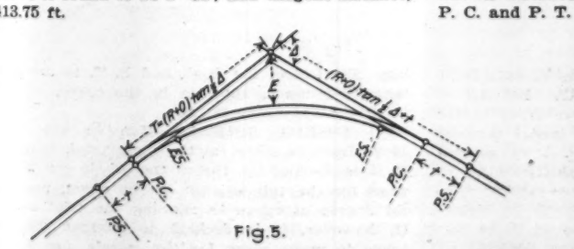

Fig. 5.

This curve, however, was found to require too great a throw. On inspection of the centers it was found that if the middle point was moved out about 0.35 ft. a curve would be obtained that would require nowhere a greater throw than 0.4 ft. Moreover, the throw inward would about equal the throw outward. Accordingly the external for a curve one minute greater was figured and found to be 22.35 ft. Using this curve, an outward throw at the middle point of 22.64 ft. — 22.35 ft. = 0.29 ft. would be obtained. As this closely approximated the throw desired at the middle point (0.35 ft.) a $1° 32'$ curve was used accordingly.

The P. C. and P. T. of the new curve were then located by measuring 413.75 ft. — 409.25 ft. = 4.50 ft. from the old curve points. The curve was staked out as a $1° 32'$ curve. Track centers were set every 50 ft. Stakes were also set back on the tangents every 100 ft. for a distance of 300 or 400 ft., to enable the section foreman to line them up to the curve.

TO INSERT SPIRALS. — As curves of this class are generally short, it is not advisable to sharpen up the main degree of curve, but probably it will be best to throw the whole curve inward for the full amount of the offset.

After the tangents have been produced to an intersection and the external to center of track measured, locate middle point of offsetted curve by measuring a distance $E + O \csc \frac{1}{2} \Delta$ from the located P. I.

Figure the tangent distance of offsetted curve from the formula

$$T = (R + O), \tan \tfrac{1}{2} \Delta. \quad \text{(See Fig. 5.)}$$

Set up the instrument over the offsetted P. C. and run in the curve, setting at first only temporary points. If the curve cannot be improved by flattening or sharpening it, stake it out, setting track centers every 50 ft. Locate the end of spiral (E. S.) by running in degrees (spiral angle) of main degree curvature.

After the main circular curve has been located thus, the spirals can be inserted by running them in from the P. S., after first sighting on E. S. (as located from the main curve) as a check.

TO RELINE A CURVE OF CLASS 2.

Where it is difficult or impossible to produce the tangents to an intersection a traverse must be run around the curve. A point is taken on one tangent in the center of the track, care being taken that this point is actually on the tangent or tangent produced. Intermediate points are selected between this point and a point similarly taken on the terminal tangent.

The angles and chords between the traverse points are then accurately measured. All angles should be repeated at least three times, and chords should be measured to the nearest hundredth of a foot. The traverse points should not be taken so far apart as to make chaining between them difficult or inaccurate. The object of this traverse is two-fold:

(1) To get the intersection angle of tangents; this is obtained by summing up all the angles of the traverse.

(2) To establish a point on each tangent at a known distance from the P. I. from which the P. C. and P. T. of the curve can be located.

Referring to Fig. 6, consider the initial tangent to be the meridian of the survey, and the first traverse point $A$ to be the "origin."

To Figure the Traverse.—Required: Intersection angle, and distances $OA$ and $OE$. Intersection angle = sum of deflection angles $= A + B + C + D + E$.

Latitude of course $AB = AB \cos A = Ab$.

Departure of course $AB = AB \sin A = Bb$.

Latitude of course $BC = BC \cos (A + B) = Bc$.

Departure of course $BC = BC \sin (A + B) = Cc$.

The latitude of any course = length of course × cos (deflection angle for that course + sum of all preceding deflection angles). And similarly for departures:

The sum of latitudes of each course = total latitude of point $E = LA$.

The sum of departures of course = total departure of point $E = LE$.

Now, in the triangle $LEO$

$$OE = LE \csc \Delta$$
$$\text{also } LO = LE \cot \Delta$$
$$\text{hence } OA = LA - LO.$$

If the traverse consists of no more than two courses it will perhaps be easier to figure the traverse by solving the two resulting triangles. See Fig. 7.

Using the old degree of curve and the intersection angle as actually measured, figure the tangent distance and external distance and set the P. C. and P. T. by measuring the proper distance from the first and last traverse points. Thus, in Fig. 7, the P. C. is located by measuring a distance = $OA$ — tangent distance ($=m$) towards the P. I. Likewise the P. T. is located by measuring a distance = $OE$ — tangent distance ($= n$) towards the P. I.

Run in the curve, setting at first only temporary points. If the curve fits the track satisfactorily, stake it out, setting track centers every 50 ft. If the curve as run requires too great a throw, a new curve should be figured by making the necessary change in the external. See under Class I curves.

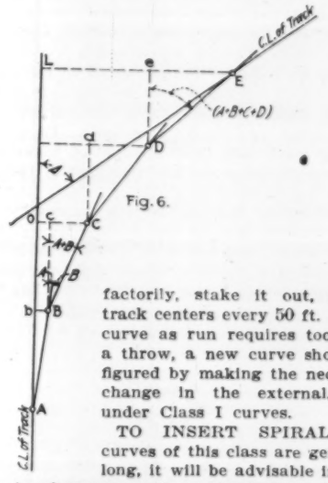

Fig. 6.

TO INSERT SPIRALS.—As curves of this class are generally long, it will be advisable in most cases to sharpen up the main degree of curve rather than throw the whole curve in for the full amount of the offset.

To do this, figure the external distance corresponding to the old degree of curve, then from the following formulas figure the degree of offsetted curve that will come in center of present track at middle point of curve. (Fig. 8.)

$$E = E^1 - O \csc \tfrac{1}{2} \Delta$$

$$\text{and } R = \frac{E}{ex \sec \tfrac{1}{2} \Delta}$$

After locating the offsetted P. C. and P. T. from the first and last traverse points, run in the curve; setting at first only temporary points. If the curve fits the track satisfactorily, stake it out, setting track centers every 50 ft. If the curve can be improved by flattening or sharpening it, figure the change necessary in the external. Reset the P. C. and P. T. to the new $O$ and $T$, and run in the curve. In this manner a curve may be produced that will require the least amount of track throw for the offset used.

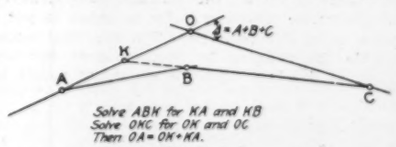

Fig. 7.

After the main curve is located, the spirals can be inserted by running them in from the P. S. As a check on the location of the spiral from the P. S. the end of spiral (E. S.) should be located from the main circular curve at the time this curve is being staked out. This is done by simply running in the spiral central angle of main degree curvature.

SPECIAL TREATMENT IN RELINING LONG CURVES OF CLASS 2.—In relining long simple curves, by the ordinary method of back-sights, a very small error near the P. C. of the curve will be greatly increased at the other end. Errors in

the manipulation of the transit, although slight in themselves, become serious when curves are long. Such errors include not setting the instrument exactly over the point, incorrect bisection of backsight, errors in turning tangent on the curve, errors in measurement. On location or construction work such errors arising in the production of long curves might fall well within the limits of accuracy with which such work is usu-

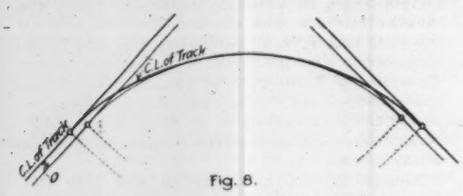

Fig. 8.

ally done. But in maintenance-of-way work, on account of the many restrictions imposed upon existing curves (and already noted), such large errors would often be inadmissible.

Therefore if accumulating errors in the re-running of long curves are to be eliminated, some method should be used which will permit of the curve being run in by foresights. Running in long curves by the usual method of backsight is the cause of the so-called "fudging" at the P. T. end of the curve.

A method of running in long curves by foresights was devised by Mr. W. R. Hillary, Engineer of Maintenance-of-Way, Pennsylvania Lines. This method is in use on many of the divisions of the Pennsylvania Lines, and the writer has found

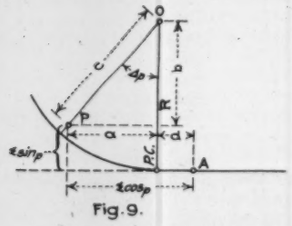

Fig. 9.

it to be a very good one (having used it successfully on many long curves). In this method, a traverse is run around the curve in the usual way, traverse points being taken at all bridges, road crossings and at all other points where the track throw is restricted within narrow limits.

After the courses and angles of the traverse are carefully measured, the total latitude and departure (referred to the initial tangent as meridian and first traverse point as origin) of each traverse point should be figured. (See method for Class 2 curves.)

With these data, we are now able to compute the "throws;" i. e., the amount each traverse point must be moved radially in order to put it on the curve selected. (See Fig. 9.) This makes possible the running in of the curve by foresights, as the instrument is set up at points lo-

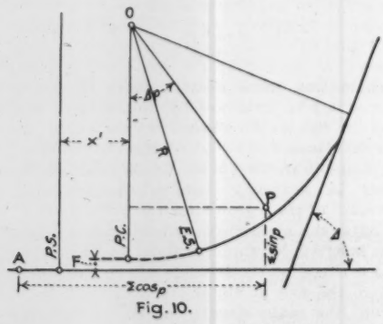

Fig. 10.

cated by measuring radially the calculated throws from each respective traverse point (toward or away from the center as the calculations indicate), and not at turning points set by the instrument, as is usually the case.

TO CALCULATE "THROWS."—Simple curve without spirals:

$$\text{Tan } \Delta_p = \frac{a}{b} = \frac{\Sigma \cos_p - d}{R - \Sigma \sin_p} \qquad C = \frac{a}{\sin \Delta_p}$$

Throw $= R - C$

If $R > C$, Throw will be outward.

If $R < C$, Throw will be inward.

Note: "p" is any traverse point on center of existing track.

Spiralled Curve:—Let $P$ be any traverse point.

$Op^1 = R + F - \Sigma \sin_p = b.$

$I'p^1 = \Sigma \cos_p - (d + x) = a$

$$\tan \Delta_p = \frac{a}{b}$$

$$OP = C = \frac{a}{\sin \Delta_p}$$

Throw (radial) $= R - C$

If $R > C$, Throw will be outward.

If $R < C$, Throw will be inward.

If traverse point $A$ falls between P. I. and P. S. its sign will be minus.

The length of the curve between the P. C. and every traverse point should now be calculated from the above partial angles of curve.

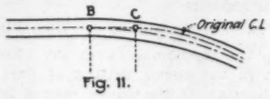

Fig. 11.

This is to serve as a check in running in the curve. (Fig. 10.)

TO RELINE CURVES OF CLASSES 1 AND 2.
(Second Method, by Trial Curves.)

Rather than produce the tangents to an intersection or run a traverse around the curve, some engineers prefer the following method of relining curves. With this method, after a little experience, a satisfactory curve can be produced, and in a much shorter time than is possible by the usual method.

1. Assume some point as the original point of curve. Since the ends of un-spiralled curves are thrown in or "eased off" by the track men, the original P. C. will generally not be found at $B$, the present point of curve, Fig. 11. It will be at some point, $C$, on the tangent produced. The assumed P. C. should therefore be selected accordingly.

2. Set up the transit over the assumed P. C. and (using the old degree of curve) run in a trial curve, setting temporary points every 100 ft. Continue the curve until it begins to run off the roadbed, at which point measure its distance to center of track. Dividing this distance by the sine of the central angle of curve up to that point gives the distance the assumed P. C. must be moved forward or back, according as the curve ran off the inside or outside of the center of track. See Fig. 12. Let $AB$ = distance of point $A$ of trial curve from center of track. Draw $AC$ parallel to initial tangent of curve. Then angle $DAC = \Delta$ = central angle to point $A$; and $LM$ (= shift) $= AC = \frac{CD}{\sin \Delta} = \frac{AB}{\sin \Delta}$ approximately.

3. Set up the instrument over the new P. C. and again deflect around the curve. This time it should be possible to get around the entire curve without any difficulty. If, however, the curve still tends to run off the roadbed, figure the change necessary in the P. C. and make a second trial.

At each turning point set a tack on a line parallel to the initial tangent, so that by stretching a string or wire from the turning point to the tack, the new position of the turning point when the final adjustment of the curve is made can be set without setting up the instrument. See Fig. 13. Care shall be taken that these tacks are accurately set in line with the initial tangent.

4. Since the present central angle of curve will probably not be the same as the original angle, due to slight shifts in the tangents, the angle of curve between the last turning point

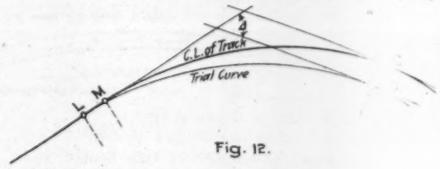

Fig. 12.

and the terminal tangent should be accurately measured. Referring to Fig. 14, this angle is equal to the sum of the angles $BAC$ and $BCA$, where $A$ is the last turning point and $C$ any point on the tangent.

5. After measuring the exact closing angle of curve, continue the curve from the last turning point until the entire central angle is consumed. The amount necessary to shift the curve in order that the tangent may come into or coincide with the track tangent can now be figured by measuring the offset between the two tangents (see Fig. 14) and dividing this distance by the sine of the whole central angle of curve. After locating the P. C. and P. T. of the shifted curve, the turning points are located by simply moving them along their respective strings the required amount. We thus have the entire curve located.

6. After the location of this curve with reference to the track has been found in this way, the exact degree of curve which will give the least throw of the track should be obtained. To obtain this, the external of the curve as run should first be figured. By an inspection of the curve centers, determine how much this external must be increased or decreased in order that the curve may more nearly fit the track. After deciding on the change necessary in the external, figure the degree of curve corresponding. Then reset the P. C. and P. T. to the new tangent distance, and run in the curve, setting track centers every 50 ft.

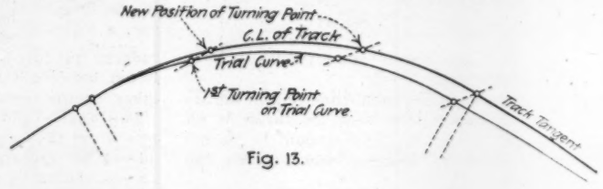

Fig. 13.

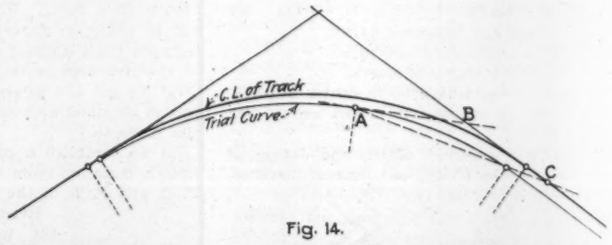

Fig. 14.

TO INSERT SPIRALS.—Run in the trial curve from an offset to the main track tangent. If it is decided to throw the whole curve inward for the full amount of the offset, use the old degree of curve in running the trial curve. If, however, it is decided to sharpen up the curve to make room for the spirals, use a degree corresponding to the external

$$E = E' - 0 \text{ csc } \tfrac{1}{2} \Delta$$

where $E$ = external of spiraled curve, and $E'$ = external of old curve. See Fig. 8.

After the main circular curve has been staked out, the spirals can be inserted by running them in from the P. S.

At the time the main curve is run in, the P. S. should be located by running in the spiral central angle of main degree curvature from the P. C.

This serves as a check on its location from the P. S.

RELINING LONG CURVES.

(Where it is necessary to compound.)

No matter how well a curve may have been staked out originally there are many ways for it to get out of line, and the longer it is left without relining with a transit the worse it is apt to become. Moreover, there is liable to be a settling of the embankment. If the curve

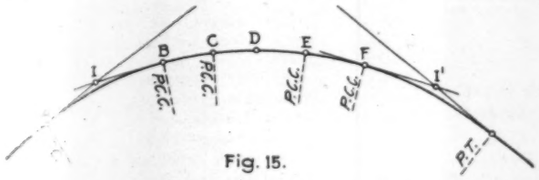


Fig. 15.

happens to be located on sidehill ground, the settlement and shifting of the embankment will often carry the roadbed and track so far out of line as to make it impossible to reline it anywhere near its original location. For this reason, in relining very long curves it may be found impracticable to use a curve of uniform radius the entire length of the curve. In order to keep the track anywhere near its present position on the roadbed it will be necessary to compound the curve. Since long curves are generally light, however, the change in degree will rarely be found to exceed five minutes. A simple curve is always to be preferred, and no curve (regardless of length) should be compounded unless absolutely necessary.

TO RELINE A LONG CURVE BY COMPOUNDING.—A. Set up at some point near the middle of curve, as at D, Fig. 15. Find by trial a curve that will fit this portion of the curve and extend it in both directions as far as possible. Let points C and E be the limits of this curve.

B. Set up over point C, turn tangent and continue the curve, compounding where necessary, until a point 500 or 600 ft. from the end of the curve is reached. Let this point be at B.

C. Set up over B, turn tangent to the curve at this point and produce same to an intersection with the main track tangent at *I*.

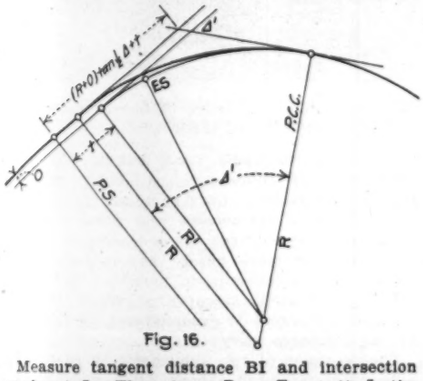


Fig. 16.

Measure tangent distance BI and intersection angle at I. Then from $R = T \cot \frac{1}{2} I$, the radius and degree of curve are found that will end in the main track tangent at A. The other end of the curve is treated in the same manner.

TO INSERT SPIRALS.—After figuring the degree of curve that will end in the main track tangent at A, Fig. 15, figure the degree of curve that will end in a parallel tangent at a distance *O* from the main track tangent. The degree of this curve is found from:

$$R = R' - \frac{O}{\text{vers } \Delta}$$

where $R'$ = radius of curve ending in main track tangent, and

$R$ = radius of curve ending in offsetted tangent

READJUSTMENT OF TANGENTS.

Few tangents of extraordinary length (or even of moderate length) are straight lines. Among the various causes leading to deviations from the true tangent are the following:

1. Errors in the manipulation of the transit in the original survey. The most frequent and also the most serious of these occur when in prolonging the line by reversal, the transitman fails to take double sightings.
2. Failure to lay track to true centers.
3. Slipping and sinking of embankment.
4. Shifting of track by the trackmen's lining bars.

The following is the recommended practice of the American Railway Engineering and Maintenance of Way Association for the readjustment of tangents:

> Tangents shall be adjusted by throwing the tangents between summits, between curves, or by throwing curves to meet tangent, or by partially throwing curves and partially throwing tangents, as may produce the least work.

In relining short tangents where the entire distance can be seen, the problem is usually an easy one. Foresights set at determining points such as bridges or objects and structures close to the track allow a man to stand at one end, or on a summit (where lateral deflections in tangents can most effectively be concealed), and shift the transit one way or the other until he is on a line that satisfies as many of the conditions as possible. See Figs. 17 and 18.

READJUSTMENT OF LONG TANGENTS.

In relining long tangents where the entire distance cannot be seen from one set-up, or where on account of excessive heat long sights are not advisable, the best plan is to make a careful survey of the existing center line and let this serve as a basis for the readjustment of the tangent.

Commencing at one end of the tangent, the track is carefully chained with a 100-ft. steel tape. The stationing is marked on the base of rail, a small pot of white lead and a brush being carried for the purpose. At every ten stations (or five stations, depending on the condition of the atmosphere) a hub is driven in the center of existing track. Referring to Fig. 19, the instrument is set up over hub at station 10, backsight taken on hub at station O, and this line produced by double sightings to a point opposite station 20. The distance that the existing center line is to the right or left of the mean point at station 20 is then carefully measured to the nearest hundredth of a foot.

The instrument is then set up over the hub at station 20, backsight taken on hub at station 10, and double sightings taken to a point opposite station 30. The distance that the existing center line is to the right or left of the mean point at station 30 is then measured as before. The work thus proceeds until the other end of the tangent is reached. The full 10 stations are taken as a fixed length of sight, and the backsight taken on the previous hub in center of track.

Points should also be taken at all important bridges and summits or other local features which may act as ruling points in the readjustment. The instrument, however, need only be set up over the 10 station hubs, it being sufficient merely to record the lateral deflections of tangent at these points.

To serve as a basis for the readjustment of the tangent a plan with lateral offsets drawn to an exaggerated scale should now be prepared. Scales of 400 ft. to the inch longitudinally, and 0.40 ft. laterally are convenient for ordinary cases. A line should not be laid down that satisfies as many of the conditions as possible, and at the same time gives the least possible throwing of track.

After the new alinement has been decided upon, scale or calculate the amount each point must be moved in order to put in on the line selected. These points can then be located by measuring the required amount from points in center of track and the new line run in, using these points as foresights.

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[As supplementary to the foregoing article by Mr. Wilms we give below descriptions of two somewhat similar methods for the same class of work.—Ed.]

LINING TANGENTS ON THE GULF, COLORADO & SANTA FE RY.

The following method of realining track on tangents on an existing railway, preparatory to ballasting, has been used by Mr. R. A. Rutledge, Resident Engineer of the Gulf, Colorado & Santa Fe Ry. The description is taken from the new edition of "Railway Track and Track Work" (now in press), and the method was first described by Mr. Rutledge in Engineering News, Nov. 1, 1906.

The endeavor is to get the tangents as nearly straight as possible, but to leave easy swings where exact lining would require an excessive amount of work. The transit being set near a curve point, the line of track is obtained, and then produced to the next intersection by the following method: Two points are located 500 or 1,000 ft. apart, according to the clearness of the atmosphere and the accuracy of the object glass. The transit is next set over the second point and a backsight taken on the first,

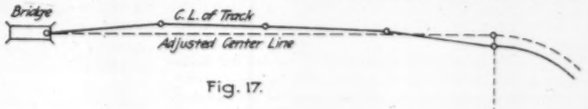



Fig. 17.

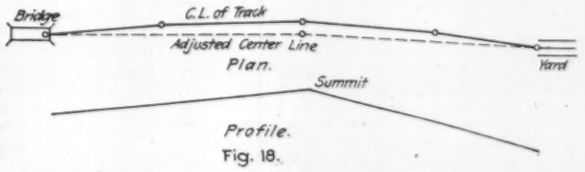



Fig. 18.

after which a third point is located the same distance ahead by reversing the transit on it with great care.

The line is thus continued forward to a point near the P. C. of the next curve, and, at each point located, the distance to the right-hand rail is measured and recorded. Inspection then shows whether this is the line that best fits the track. If not, a simple calculation will show at which point to swing the line to fit the track, the idea being to get a tangent that will fit the track as it is on the ground and save as much relining as possible. When the line is decided on, a calculation is made as to how much each point already set, has to be moved to get it on this line. They are then measured in, using a tape graduated to hundredths. The transit is then set over alternate points on the selected line, and run each way by foresights, in this way getting as near a straight line as can be run, and at the same time reducing the track work to a minimum.

On curves, the intersection points are obtained either by running the tangents to their intersection, or by running in long chords and calculating the curve point if the intersection is difficult of access. After establishing the curve points, the curve is run in and temporary points are established at each station. The distance from each temporary point to the outside rail is measured and recorded, after which (by calculating the external for the curve at the given degree, and for another curve either

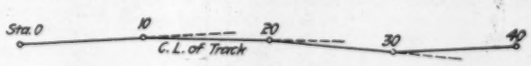



Fig. 19.

one minute more or less) it can be seen whether the curve can be improved by flattening or sharpening it.

In all the work the reduction of track work is kept in mind. This method makes work for the instrumentman, but the work of a party of three engineers may save that of a track gang of 50 to 100 men.

LINING TRACK FOR MAINTENANCE-OF-WAY.

The following review of the practical considerations to be observed in lining track for maintenance-of-way is from a paper on "Maintenance of Line," by Mr. H. C. Landon, Roadmaster of the Pittsburg, Shawmut & Northern Ry., which was presented with the report of the Track Committee of the American Railway Engineering and Maintenance of Way Association in 1901.

With the increased speed of locomotives and trains

comes the demand for a nearer perfection of line on tangents and curves. The permanency depends first upon the soil, and then upon the character and amount of ballast. The foundation of all track being the earth, no matter what ballast is placed thereon, it is impossible to maintain the line perfectly except at points where it passes over permanent structures in which no settlement is possible. The approach toward the maintenance of perfect line depends entirely upon the character of the ballast and the amount of traffic which goes over it.

A road having light traffic and light locomotives and comparatively slow passenger trains is not called upon to try for that perfection of line that is necessary for a road having heavy traffic and using heavy equipment. At all times such line and surface should be maintained that the road is perfectly safe for the traffic that is moving over it.

Where the passenger business is light and passenger trains are comparatively slow, and also where most of the business is freight, if the track is slightly out of line it does not affect the comfort of passengers, nor is there any particular danger. If it was endeavored to keep such track in perfect alinement the expense would be a waste rather than an economy. There should be, however, a tendency, no matter what the traffic may be, toward getting the line in the best possible shape under the existing conditions. The track, as originally staked out, does not at all points remain as laid, nor is track laid always with the proper care. Center stakes are not followed, and frequently in tracing the old line it is found that track has moved from 1 to 2 ft. or more, either from the settling of the tracks, or by the action of the trackmen's lining bars. This deviation from the original line on curves often produces sharp places which cause a disagreeable throw.

Of 19 roads replying to a circular, 10 set center stakes with the transit, placing them from 100 to 200 ft. apart, so as to move the track as little as possible on tangents. The track is thrown to center stakes by trackmen in the most convenient season, and this is ordinarily when the road is being re-tied, or ballasted. Tangents are thrown then to exactly straight line. There is a good deal of labor saved in this method of lining, as the track is thrown to where it belongs and the work of lining is practically completed as the section gang goes over it.

One side of the track, or the rail on the mile-post side, is usually taken for the line side of the track by the foreman in realining the track. Where the tangents are short and the curves realined, the tangents are frequently lined by the eye between the points of curves. Track lining should, if possible, be done before surfacing.

Curves should be adjusted in the same manner as tangents. Center stakes should be set. Of the 19 roads, 16 made it a practice to put curves in proper line by setting stakes with the transit. While none of them so state, it is presumed that the work of throwing or adjusting track after the stakes are set is done when the track is being worked over. Very poor alinement can be greatly improved by the introduction of easement or spiral curves, and these improvements can usually be made without varying from the old alinement sufficiently to have the track itself on a new roadbed.

Of the 19 roads, 14 use some form of easement curve. One road states that having found no particular advantage in the easement curve, its use has been abandoned. It would seem, however, from the large number of roads using easement curves, that some form of easement curve is necessary to obtain the best results.

Three roads use some form of the Searles spiral; two roads use some form of the Holbrook spiral, and one uses the cubic parabola. Any form of curve which gradually changes the degree of curvature will probably answer, but that form of spiral which changes the curve and makes a long and easy approach to a curve will give the best results. One railway uses the Holbrook spiral, which changes 1° in every 100 ft. of its length. Sharper easements are used when it is necessary. This makes a very easy approach to a curve, as the elevation changes very gradually. The Erie Ry. did use for its standard a spiral changing 1° in every 60 ft. This spiral makes a light and easy change from tangent to curve. The change in curvature and elevation is light and easy. With this spiral, at a speed of 40 miles per hour, a train will pass over 1° of curvature, and, say 1 in. of change in elevation per second. Even at the rate of 60 miles per hour it would pass through the same distance in about two-thirds of a second. At the rate of 60 miles per hour, this easement curve would produce no ill-effects, although for a rate of 60 miles per hour a lighter easement than 60 ft. per degree is desirable, and should be used where practicable. Where conditions have made it necessary, spirals changing 1° every 15 ft. have been used to advantage with speeds of 45 miles per hour.

Generally the easement curves are used and applied to all curves of 2° or more and between parts of the compound curve where curvature differs more than 2°. Stakes in the easement curve should be set not farther apart than 25 or 30 ft. The labor of locating an easement curve is but little more than that of the circular arc. It is advisable, on high-speed lines, to use easements with curves of 1° and over. On the Vandalia line, curves of 30′ or more are eased with the Holbrook spiral.

Transition curves enable the elevation to rise uniformly as the curvature increases. If the circular arc is at the proper elevation, then the train movement passes from the tangent to the circular arc uniformly with the increase in elevation.

Perfect line is probably unknown. It is the endeavor, in order to realize the best service, to attain as nearly perfect alinement as possible. Tangents and curves should be laid to exact line and curvature (allowance being made for expansion), and the track then accurately gaged. Careful gaging of track materially helps in the maintaining of line. The surface must also be maintained. The track level should always be used in surfacing track. This is not always insisted upon, or not always done.

## A 15,000-KW. OIL-BURNING STEAM POWER PLANT ON WHICH A BONUS OF $363,310 WAS EARNED.*

The recently completed steam power plant of the Pacific Light & Power Co., at Redondo, Cal., has several features of unusual interest: the designers adopted 6,700-HP. reciprocating engines in place of the steam turbines which might have been used; the plant is the first reported in which fuel oil, from the immediate locality of the station has been automatically fired; and the contractors earned an unusually large bonus on the operating efficiency of the plant.

The contract was let for a fixed sum with a guarantee of a certain plant economy under commercial operation with a railway load. The plant was also to be started by the contractors and operated by them for at least three months previous to the economy test, and also during the test, in order to thoroughly organize the operating force and adjust the apparatus.

The test to determine the economy of the plant was to have been of 90 days' duration on one unit operating on commerical railway load. Inasmuch as the plant had been operating regularly over six months previous to the time of the test, it was considered that the endurance run was unnecessary. The test period was, therefore, reduced from 90 to 15 days. On the results of the test, the contractors claim the largest bonus ever paid on a steam-plant guarantee and the best steam-driven central-station economy figures yet published. The contract was placed with Chas. C. Moore & Co., of San Francisco, and covered the entire installation, including machinery foundations and excepting only the switchboard, buildings, pipe line for circulating water and all outside work.

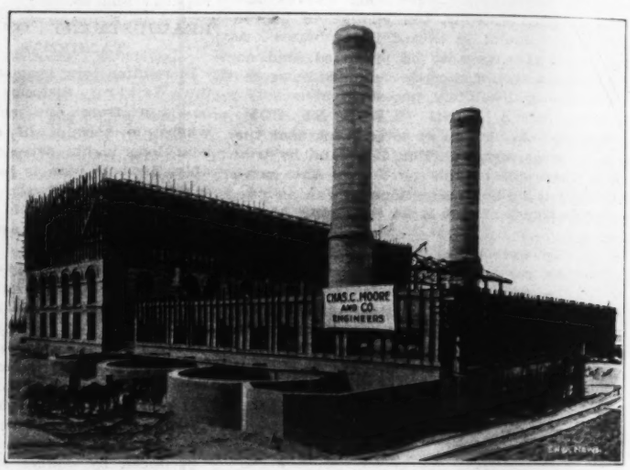



FIG. 1. BUILDING FOR REDONDO POWER PLANT IN CONSTRUCTION. OIL-TANK PITS SHOWN IN FOREGROUND.

The Pacific Light & Power Co. has both lighting and power load, although the greater part of the current from this station is used for operating the railways of Los Angeles and suburban towns, including all of the Huntington system of interurban railroads. In order to obtain an ample supply of water for condensing purposes, the plant was located at Redondo, a beach town 18 miles southwest of Los Angeles. The fuel situation is ideal. Crude oil is obtained from wells, near the plant, in which the company is largely interested. Owing to the system of oil firing in use, the boiler-room labor cost is a minimum. In view of these facts and of the economy attained, the contractors claim that this plant is developing steam power at a cost never before attained.

The station has been successfully operated in parallel with other water and steam power plants belonging to the Pacific Light & Power Co.

The design was arranged in independent panels and a further subdivision was possible, as each engine was in reality two complete [illegible] pound engines working on one shaft; each had an independent steam and exhaust connection and there is a separate condenser for each low-pressure cylinder. Each high-pressure cylinder is connected to a half panel of boiler equipment. While there are three main units, it is claimed that this subdivision outlined gives the freedom from a complete breakdown corresponding to six units.

All auxiliaries, except the air pumps, are steam driven and operate non-condensing, the steam exhaust passing to feed-water heaters. The air pumps for the condensers are motor driven from the main generators. A special system of suction and discharge pipes for the condensing water was necessary as, in this location, the use of a conduit or canal was considered impossible. There are two 50-in. suction mains and one discharge line of the same size. These are supported on a pile wharf and carried out to deep water at low tide. The pipes are primed by a large motor-driven vacuum pump operating through a stand-pipe to prevent carrying water into the vacuum cylinders. After suction is started, circulation is maintained by three engine-driven centrifugal pumps located in the pump pit. Each pump has separate connections to both suction lines. All pumps discharge into a common supply main, having inlet connections to all condensers. All condenser outlets are connected to the one return main. With this system of condensers any pump may be used to supply any set of condensers, although, when two or more pumps are running, their operation is necessarily in parallel. The regulation of relative amounts of water through various condensers is accomplished by the condenser discharge valves.

The provision of two condensers on each unit, with cross-connected exhaust, is a marked feature of this installation. Should it become necessary for one condenser to be cut out of service, the exhaust steam from both low-pressure cylinders may be led to the remaining condenser, making operation non-condensing unnecessary, except for a failure of circulating water or the breakdown of both condensers at one time. It is claimed that actual operation shows but a small falling off in vacuum due to the double load on one condenser.

The feed water is filtered to remove excessive amounts of cylinder oil, although no attempt is made at complete separation. Entrained oil in the exhaust from the auxiliaries is so completely removed by separators that this steam when condensed in closed heaters may be drawn off as clear as drinking water.

BOILERS.—There are 18 Babcock & Wilcox water-tube boilers, arranged in nine batteries of two boilers each. These boilers are standard except in having 6,042 sq. ft. of heating sur-

*Arranged from information supplied by the Engineering Department of Chas. C. Moore & Co., San Francisco, Cal.

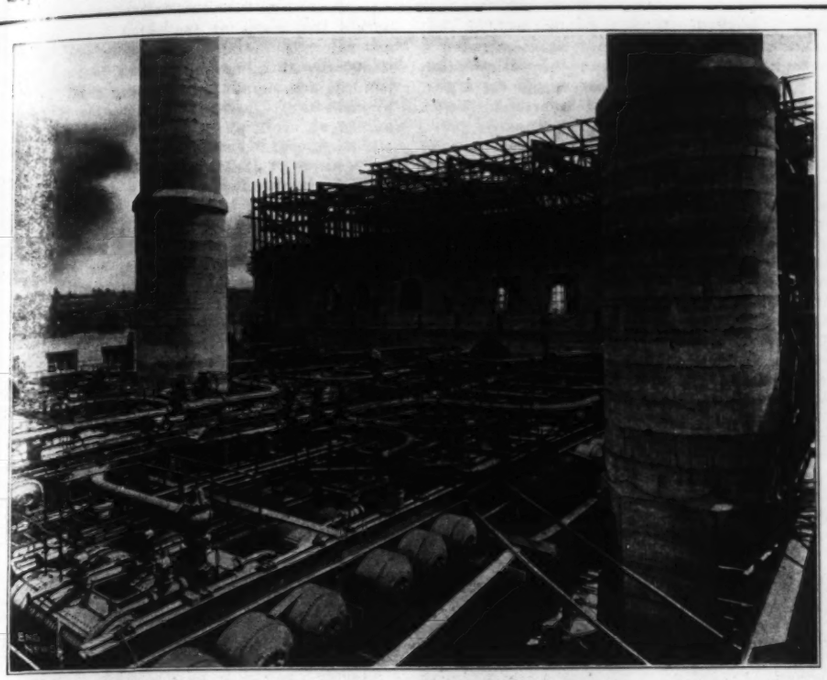


FIG. 2. BOILER ROOM OF REDONDO PLANT, SHOWING SIMULTANEOUS INSTALLATION OF BOILERS AND ERECTION OF WALLS.

face per boiler and are designed for a working pressure of 200 lbs. per sq. in. Each boiler has one superheater designed to give approximately 100° F. superheat at the boiler nozzle.

Patent, fuel-oil burning furnaces, of the Peabody type, have been provided, three burners per boiler. The oil is fired from the bridge wall forward, but the fire is controlled from the boiler front.

FUEL OIL PLANT.—Fuel oil is stored in large steel tanks having a storage capacity for from 30 to 45 days. The oil is pumped into auxiliary tanks outside the boiler-room, each tank having a capacity of 1,000 bbls. The top of the auxiliary tanks is on the same level as the boiler-room floor line, to conform to the underwriters' requirements. The grade line is about 14 ft. above the floor of the tanks, and the surrounding earth is withheld by means of circular retaining walls. These tank pits are roofed over and properly ventilated. All pipes connecting to tanks have valves located on the boiler-room side, there being a 3-ft. concrete wall between the tank compartments and the operator. There are fire partitions between adjacent tanks and connecting fireproof doors. The manhole covers in each tank are padlocked, so that it is impossible for an operator to set fire to any of the tanks as finally designed, although a fire did occur before these precautions were adopted. In lieu of steam-smothering pipes leading to the interior tank compartment, there is placed above each tank a steam ring of 4-in. pipe, having an ample number of jets to provide a sheet of steam which would effectually cut off any supply of air from the outside and promptly smother a fire which might be started by any possible means.

As originally laid out there was provided a duplicate set of oil pumps for each unit, or six oil pumps in all. The plant has so far been operated in this way, although it is now being remodeled to have one set of pumps supply the entire station, requiring but one pump operator instead of three on each shift.

An automatic system of regulation is employed, invented by J. R. Atchison and C. R. Weymouth, engineers for Chas. C. Moore & Co., the contractors. The oil is pumped under pressures varying from 10 to 50 lbs., depending on load conditions, there being a uniform oil pressure throughout all portions of the plant, all burners being wide open or nearly so. The amount of oil burned, with variations of load, is controlled by the pressure of oil at the oil pumps, the intensity of fire increasing and decreasing in all boilers simultaneously. The oil pressure is automatically controlled by a steam-pressure regulator, the variations in oil pressure and intensity of fire being such as to maintain a uniform steam pressure on the plant.

Steam for atomizing the oil is supplied to the oil burners by a separate, low-pressure main, the pressure in this main being automatically controlled by variations of oil pressure in the oil main. An automatic ratio regulator is used to maintain such pressure in the low-pressure steam main as is necessary to atomize that particular amount of oil burned, corresponding to any momentary oil pressure. In this particular plant it is found that the proper amount of steam for atomizing purposes is furnished under a steam pressure equal to three times the oil pressure plus 30. This relationship varies with the type of burner used, relative areas of burner orifices for steam and oil.

The air supply for combustion is controlled by a damper controller, also automatic, which increases the damper opening with an increase in oil pressure and vice versa. The movement of the controlling lever is due to the oil pressure acting on a diaphragm. This movement is opposed by the action of a spring, such that the amount of movement on the main lever is proportional to the oil pressure. This movement is multiplied through a hydraulic cylinder connecting to a rocker shaft running over all of the boilers in one panel, and to this each boiler damper is connected. The connecting levers are set at such angularity, with respect to the connecting rods operating the dampers, as to give the proper air supply for the various ranges of loads, the final adjustment being from actual trial at the plant.

In actual operation and test, it is claimed that this automatic system of control is safe, reliable and has met with the endorsement of the firemen.

The boilers are equipped with secondary, sliding, tight-fitting dampers, which are completely closed during the stand-by period to prevent any slight circulation of cold air through the boiler settings.

ENGINES.—The plant includes three 34 and 70 × 56-in., double, horizontal-vertical, compound, side crank, automatic engines (McIntosh & Seymour), each direct connected to a 5,000-KW., 50-cycle, 18,000-volt, fly-wheel type alternator. The generating unit runs at 100 r. p. m. Each engine of this type, it may be remembered, has two horizontal, high-pressure cylinders and two vertical, low-pressure cylinders. The engine governor is designed to go onto the rotor of the generator. The engines are built with grid-iron valves; the admission and exhaust for all cylinders are operated from fixed eccentrics, while the point of cut-off for each cylinder is controlled by an auxiliary valve actuated by the single engine governor.

Each engine is also fitted with an electrically-operated, speed-changing mechanism, located in the governor, operated by a small induction motor and controlled from the switchboard gallery. This not only allows the engine to be speeded up or down four or five revolutions

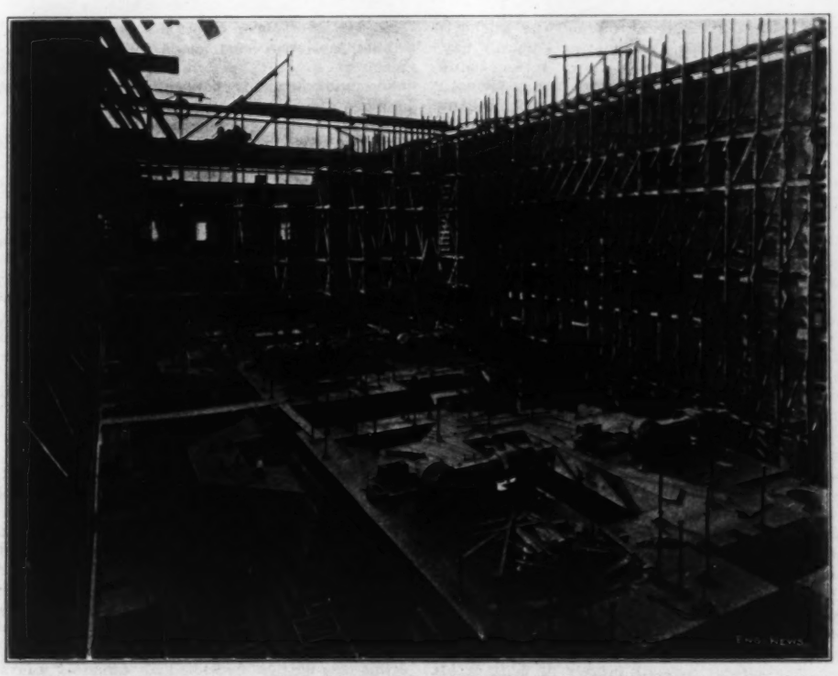


FIG. 3. ENGINE ROOM OF REDONDO PLANT, SHOWING SUB-FOUNDATION SLAB, MAIN-ENGINE FOUNDATIONS AND EXCITER-UNIT SLABS.

while running, to bring two or more engines into synchronism, but is also used to divide the load between engines.

CONDENSERS.—The plant contains six surface condensers (Wheeler "Admiralty"). Each is connected to a low-pressure cylinder of the main units and has 5,200 sq. ft. of cooling surface. In addition to the regular cooling surface of each condenser, there is provided, in the upper compartment, a series of tubes comprising what is termed the "Volz heater." After being discharged from the air pump, the condensed water passes through this heater under atmospheric pressure and is heated to within a few degress of the temperature of the exhaust steam surrounding the heater tubes. The make-up water is also brought in at this point, securing the benefit of heat which would otherwise be wasted.

PIPING.—Owing to the necessity for long radius bends and the desire for flexibility, it was determined not to employ any steam pipes over 14 ins. in diameter, the diameter of the engine throttle valve. It was finally decided to connect three boilers in each battery to each side of each unit; thus providing a greater flexibility of service without increasing the cost of the piping system. The main steam piping was anchored to the building walls, the building columns having been located with this in view. It was found, however, that the columns were not sufficiently rigid for anchorage purposes, and it became necessary to install a cross system of bracing from wall to wall. Drainage is afforded by locating a large receiver drum in each line of piping.

COOLING SYSTEM FOR MAIN ENGINE BEARINGS.—For the purpose of providing circulating water for cooling main-engine bearings and guides, a set of circulating pumps and intercooler have been furnished. Fresh water is circulated through the engine parts and is coo'ed by means of a small surface condenser. Here the fresh water for cooling flows within the tubes and salt water is circulated around the tubes, being taken from condensing-water suction mains.

CHIMNEYS.—There are two reinforced-concrete chimneys, each 13 ft. in diameter and 125 ft. in height. Each chimney has capacity for two units, the plant being arranged so that a fourth unit may be added to the station and connected to the second chimney. The chimney gases pass from boiler to chimney through specially designed reinforced-concrete flues. These have proven entirely satisfactory for the work, although slight heat cracks in the concrete appear in various places.

FOUNDATIONS.—The plant is installed on the beach within a few hundred feet of the surf line. The subsoil consists largely of drift or pit sand. In order to prevent vibration due to the main engines, the design of sub-foundation was carefully studied. It was finally decided that in lieu of piling, there would be constructed a sub-foundation 6 ft. in depth the entire width and length of the engine room, except for a 2-ft. space all around to prevent interference with building foundations.

This huge slab is reinforced at the top and bottom. The main engine foundations were built directly on top of this slab, rising 14 ft. to the engine-room floor line. Foundations for exciter engines were made by throwing reinforced-concrete slabs over the space between adjacent units, thus still affording ample space underneath for rheostats, filters, etc.

BUILDING.—Building, building foundations, wharf and circulating-water pipe line were designed and installed under the direction of Edwards S. Cobb, Chief Engineer for the Pacific Light & Power Co. The building is entirely of reinforced concrete, and was built by Carl Leonardt, a prominent Southern California contractor. The installation of machinery and the erection of the building proceeded together, as may be seen from the accompanying figures.

OPERATION OF THE PLANT.—One of the difficulties yet to be solved by the company is the elimination of sea weed and more particularly the fine sea moss from the circulating water which fouls the condensers and gives rise to a frequent loss of vacuum, compelling operation non-condensing. It happens that in the warm climate along the entire southern coast, there is a large marine growth, consisting not only of kelp but also the finer sea moss. It is impracticable to handle this effectively with any type or any make of enclosed strainer. It is probable that some type of open-canal screens will be used to remove this most objectionable difficulty.

Some very interesting results have been accomplished at this station in the handling of condensing apparatus during difficulties with sea weed. As stated above, there are supplied two condensers for each unit. The entire exhaust steam from one unit has been handled by one condenser, the other condenser being temporarily out of service, due to the accumulation of sea weed; the loss of vacuum due to this overloading of one condenser has varied only from 1½ to 2 ins.

The circulating water system was designed to operate on the siphon principle, requiring but a nominal head of from 15 to 20 ft. on pumps. This head at times of accumulation of sea weed would rise to 35 ft. and more. Even with the quantity of auxiliary exhaust steam due to this head, the amount was below the capacity of the feed water heater, so that no exhaust steam was wasted under any normal condition of running.

GUARANTEE AND TEST.—The contract covering this station embodied an economy guarantee providing for a 90-day test on one unit on a commercial railway load, under any load curve within the limits of the rated capac[illegible] of the generator, the total output being not [illegible] than 60,000 KW.-hrs., nor more than 78,000 [illegible]-hrs. per 19½ hrs. running, there being a 4½ [illegible] stand-by each day. On this load the contra[illegible] guaranteed an economy of 170 KW.-hrs. [illegible] bbl. of oil; each barrel weighing 334 lbs.; th[illegible] having a value of 18,500 B. T. U. per lb. [illegible] contract provision for a 90-day test w[illegible] subsequently modified to cover a period o[illegible] days since the test was not run until six mo[illegible] after the first operation of the plant and w[illegible] running conditions had presumably becom[illegible] rmal.

The test was in charge of a commi[illegible] composed of Mr. E. G. Cobb for the Pacif[illegible] ght & Power Co., Mr. C. R. Weymouth for [illegible]s. C. Moore & Co., the contractors, and, as [illegible] utral member, Prof. C. L. Cory, of the Univ[illegible]ty of California.

The test is reported to have been [illegible] most elaborate ever made on a steam plant [illegible] least in that part of the country. The expe[illegible], it is claimed, amounted to several thousand dollars, as there were engaged a total of about [illegible] men.

It is stated that this test was made on a complete unit, omitting the power consumption of the circulating-water pump. The actual head under which the plant now works, due to seaweed difficulties, varies from 30 to 35 ft. The contract provided that the company should supply a siphon system of circulating-water piping, such that the total head of friction and flow would not exceed 5 ft. An allowance was made for the omission of the circulating pump energy by deducting a suitable sum from the total bonus earned. It is claimed that the reduction in economy due to the energy to drive the circulating pump would have been a small fraction of 1%, in view of the fact that all of the exhaust steam would have been utilized in the feed water heater.

The testing committee's report gave the average result of the 15 days trial as 252.842 KW.-hrs. per bbl of oil. There is in this result a slight correction in favor of the contractors due to an excessive sulphur and moisture content of the oil. This record is claimed to eclipse all published statements of economy of large power plants, operating under commercial conditions. For purposes of comparison with Eastern results, the above economy is equivalent to slightly less than 25,000 B. T. U. in the fuel consumed, per KW.-hr. of net output.

The bonus earned as a result of the above economy was $363,310, which is probably the largest bonus ever paid on a power-plant guarantee. At the time this contract was closed it was necessary for the power company to have substantial protection as to the cost of power produced by this station, the plant output being contracted in advance at rates calculated from the guaranteed economy, which in itself was in advance of any economy then realized with fuel

FIG. 4. COMPLETED ENGINE ROOM OF THE REDONDO POWER PLANT OF THE PACIFIC LIGHT & POWER CO.

FIG. 5. FRONTS OF OIL-FIRED BOILERS, REDONDO PLANT.

oil. While it is said none expected such a great gain over the stated economy, yet from the very nature of its business, sound business policy offered to the management no alternative than these guaranteed stipulations. Basing calculations on the local market price of crude oil, it is claimed that the fuel saving due to this gain in economy will pay the full amount of the bonus in from two to three years, thus making this bond a gilt-edge investment.

COMPARISON WITH TURBINE STATIONS—It may be surprising to some engineers that a power plant of this magnitude should be undertaken with the use of reciprocating engines rather than turbines. At the time this contract was drawn, a most careful investigation was made by the Pacific Light & Power Co. under the direction of its General Manager, Mr. A. C. Balch. As a result of most extensive inquiries and investigations, Mr. Balch determined in favor of reciprocating engines for this location. From the standpoint of economy, it is contended, this selection has been amply justified. On the score of space, there is claimed to be less advantage than many engineers would expect. The center distance between the engines is 43 ft. Had the exciters been located elsewhere, this distance could have been reduced to 35 ft. The first cost of this plant has not exceeded that of a turbine plant by 5%.

The power plant proper was designed by Mr. C. R. Weymouth, M. Am. Soc. M. E., in charge of the engineering department of Chas. C. Moore & Co.

## ELBRIDGE HARLOW BECKLER.

By J. H. ELLISON.*

Elbridge H. Beckler, former Chief Engineer of the Pacific extension of the Great Northern Ry., and in the last five years a member of the contracting firm of Winston Bros. Co., died suddenly of cerebral hemorrhage on Aug. 26, 1908, at the West Portal camp of the St. Paul Pass tunnel, in Shoshone County, Idaho. At the time of his death he was actively engaged in his work in connection with the Coast extension of the Chicago, Milwaukee & St. Paul Ry.

Mr. Beckler was born in Boston, Mass., on Oct. 16, 1854, and removed with his parents about nine years later to Livermore Center, Me. In 1874 he entered Maine State College, at Orono, as a junior, and in 1876 graduated with the degree of Civil Engineer. Previous to entering college, he had completed a course at Maine Wesleyan Seminary, Kents Hill, Me., where special attention to mathematics and some practice in surveying equipped him for going through the four-year engineering course in two years.

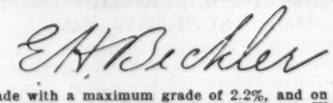
In the spring of 1877, after some months spent in teaching, he went to Minnesota to seek work in railway construction, but the business conditions of that period made it necessary to take up any work that offered: teaching, farming, surveying and map-making, during the next two years. In 1879, finally, he became transitman and Assistant Engineer on the St. Paul, Minneapolis & Manitoba R. R., at Fergus Falls, Minn. The following year he entered the employ of the Northern Pacific, whose track then ended some 60 miles west of Mandan, N. D., and his party ran the location much of the way to the Yellowstone River and beyond to Helena, Mont, locating about 400 miles of line. In 1883 he was placed in charge of 40 miles of heavy construction work on this line, including the 3,610 ft. tunnel at Bozeman Pass. During this period also the construction of a long bridge making entrance into Duluth, Minn., was in his care. His connection with the Northern Pacific lasted from 1880 to 1886, with the exception of six months in 1884 when he was engaged in location and construction for the Canadian Pacific Ry. along the Kicking Horse River, on the western slope of the Rockies.

In 1886 Mr. Beckler took up the location of the Montana Central Ry., the beginning of the Great Northern extension to the Pacific Coast. Rising through the positions of Locating Engineer, Assistant Engineer and Assistant Chief Engineer, in 1889 he became Chief Engineer in charge of the entire work to the Coast, about 1,000 miles of road from Central Montana to Puget Sound. In this position, which he held to the completion of the work in 1892, he accomplished a remarkable piece of work, generally regarded as the most notable achievement of his life; the line which he built is still highly regarded as a model of scientific adjustment to the country, and set a record of efficiency and economy which has rarely been equaled.

*Of Winston Brothers Co., Missoula, Mont.

Quoting from Engineering News of Oct. 5, 1893, p. 272, on the occasion of Mr. Beckler's election as Honorary Member of the Montana Society of Civil Engineers:

> In conferring this honor the society did so in recognition of Mr. Beckler's high attainments as engineer, and especially in view of the high professional ability he displayed in the location and construction of the Pacific extension of the Great Northern Ry., of which he was the Chief Engineer. In the accomplishment of this great work he secured a route through the main range of the Rocky Mountains with lower gradients than any other transcontinental line, the maximum gradient east of the summit being but 1%, and west of the summit 1.8%. The crossing of the Cascade Mountains



> is made with a maximum grade of 2.2%, and on a route so direct that the distance from Spokane, Wash., to Puget Sound is shortened 94 miles over any other route. The location for most of the distance was through an unexplored and mountainous country, and the work of construction under Mr. Beckler's direction was pushed in a manner heretofore unequaled in railway building and tracklaying. The entire distance of 818 miles was completed in a little over two years from the time construction work was inaugurated.

In 1893 Mr. Beckler moved to Chicago, Ill., and, making that city his headquarters, engaged in various pieces of work in the line of his profession, acting principally as Consulting Engineer. During this period, however, he constructed a narrow-gage railway in Arizona, for the United Verde Copper Co.

In 1895 he entered the service of Winston Brothers, contractors, and remained in their service until 1902, when he became a stockholder and director in Winston Brothers Co., a corporation produced by the reorganization of Winston Brothers. This relation he maintained to the end of his life.

Mr. Beckler married, in 1880, Miss Mera Rogers, of Richmond, Me., who with two daughters survive him.

Mr. Beckler was Member of the American Society of Civil Engineers, Member of the Western Society of Engineers, and Honorary Member of the Montana Society of Engineers, of which latter society he was a charter member, and which he was largely instrumental in organizing. He possessed to a remarkable degree the qualifications and instincts of an engineer, and in addition to his qualities as an engineer, was of conspicuous executive ability. He was a man of untiring energy, and singular devotion to his work. His high ideals and delicate sense of honor, together with his uniform consideration and ready sympathy, made all who knew him his friends. His life was an inspiration to all who were privileged to know him well, and in his untimely death they suffered a loss which cannot be repaired.

## ELECTROCHEMICAL CLEANING BATHS AND THEIR COMMERCIAL USES.*

By CHARLES H. PROCTOR.†

In the art of electrodepositing metals, two conditions are absolutely necessary for successful results. The first is a chemically clean metallic surface; the second, the proper composition of the depositing bath. With these two essentials duly in order, the results can never be in doubt.

To the methods of arriving at the former condition it is my desire to call your attention in this paper, and primarily to the cleansing of the metallic surface by the aid of the electric current. From the earliest introduction of the art of electroplating it has been the aim of the operator to produce a purely clean surface, realizing the fact that to produce a perfect union of the deposited metal upon the baser metal this was an absolute necessity. The methods of producing this desired result for many years were practically the same.

In the years gone by so much care was exercised in cleaning the metallic surface that such metals as copper, bronze and brass, after being highly polished, were afterwards scoured by the aid of various substances, thereby producing a dull surface that was supposed to be a necessity, because the early operators were under the impression that the deposit would not stick to a polished surface. At the present time we know that it is just as easy to produce a successful deposit upon a polished surface as upon a surface that is unfinished. There is always one factor to be taken care of and that is oxidation. As oxygen is always present in the atmosphere, it will, with its well known affinity for most metals, oftentimes in the space of a few moments form an oxide upon the surface of the metal which is invisible to the eye and yet sufficient in some baths, like nickel, to prevent a true adhesion of the deposited metal.

Several years ago a surprise was introduced among the electrodepositors of metals, in the news that a well-known manufacturer was cleansing his goods, made of iron and steel, by electricity and for some time the minds of many platers were at work to know how this could be accomplished. Finally the light came. It was announced that alkaline substances, such as sodium carbonate, potassium carbonate, potassium hydroxide and sodium hydroxide in solution, in varying degrees of concentration and with small proportions of potassium cyanide added, would, with a sufficiently strong electric current of from four to eight volts and nearly at boiling temperature, develop sufficient hydrogen to remove entirely all organic substances from the surface of the metal, thereby leaving it chemically clean.

In October, 1905, the first article that appeared on the subject of electrochemical cleaning was published in "Metal Industry" by the writer, and from that time the use of this method has been constantly increasing, until at the present time very few large concerns, especially among those engaged in the manufacture of hardware, are without electrochemical cleaning baths, which have proved so successful in the cleansing of many articles at a great saving of labor.

This method has also brought into the market several new combinations which are sold under the name of "electro-chemical cleaning salts," and have given very satisfactory results.

The action of an electro-cleanser is similar to the action of an electroplating bath. The only difference, as far as the development of gases is concerned, is that no metal is in solution and the anode being insoluble, no metal is deposited. But with a strong current a copious evolution of oxyhydrogen gas is developed upon the articles, which attacks the organic matter upon the surface, practically lifting it off and by rapid evolution of the gases carries it to the surface. The small quantity of potassium cyanide contained in solution absorbs the slight oxidation that might be upon the surface, and by the combined action produces a surface clean enough, after washing in clear water, for any deposits.

The arrangement of an electro-cleaning bath is very simple. Prepare a wrought-iron tank of proportions best adapted to the work to be cleansed. This should be heated with steam coils of iron. Across the top of the tank an insulated frame should be constructed. Upon this frame place three conducting bars, as on the regular plating bath. To the two outside bars the positive leads should be carried direct. To the center bar the negative current is connected with cable of the same dimensions. No rheostats are necessary. The stronger the current the greater the evolution of gases and the quicker the cleansing operation is accomplished.

*Slightly condensed from a paper presented at the convention of the American Foundrymen's Association, Toronto, Ont., June 9-11, 1908.

†Arlington, N. J.

Although direct contact can be made with the positive leads to the tank itself, in practice, better results have been obtained with anodes of sheet iron not more than 6 ins. wide and of a length in proportion to the depth of the tank.

The electro-cleaning solution should consist (for ordinary purposes) of 3 to 4 ozs. caustic potash to each gallon of water, and to every 100 gals. of solution, 8 ozs. of cyanide of potassium. This can be varied according to conditions. It is advisable to add at least ¼-lb. of cyanide each week. Where the articles, such as iron or steel, contain much oil or grease upon the surface, the density of the solution can be increased. For articles of brass, copper or bronze that have been polished, use a solution of carbonate of soda in the proportion of 2 ozs. of soda and ¼-oz. caustic potash to each gallon of water, with the addition of 4 ozs. of cyanide to every 100 gals. of solution. If there is much organic matter upon the surface of the articles to be cleansed, it is advisable, where air pressure can be obtained from an ordinary blower, to arrange a pipe so that the current of air can be deflected upon the surface of the solution, to keep the center of the solution clear of the insoluble substance that arises to the surface. When the cleanser is at rest, as much of this matter should be removed as possible.

It should be the aim of the operator to use the same methods of avoiding all unnecessary contamination as he would in electro-depositing baths. It is obvious even to those who have not practiced this method of cleansing metallic articles that large quantities of work can be treated very rapidly, and this is the case especially where frames or racks are used in the plating operations. On account of the rapidity of operation and the efficiency of the bath, this method of cleansing should be a part of the labor saving devices used in all great commercial establishments engaged in the electroplating of metals.

## A NEW AND SIMPLE TYPE OF SEXTANT.

In a recent issue of "The Physical Review," Prof. L. A. Freudenberger* describes a new type of sextant that he has invented which is somewhat simpler in construction than the ordinary sextant and which is more accurate, on account of the unit ratio of arm movement to scale reading instead of the double ratio in the older instrument. The new sextant is described as follows:

The ordinary sextant makes use of the well known law of reflection—that the reflected and incident rays make equal angles with the normal to the mirror surface—in order to obtain a movement of a vernier arm of half the angle measured. The arc is graduated, however, to read the angle directly. In the new type of sextant devised by the writer, the law of reflection, that the incident and reflected ray lie in the same plane, normal to the mirror surface, is taken advantage of to make the angular movement of the Vernier-arm equal to the angle measured. The principle of the new type of sextant is substantially shown in the diagram in the accompanying figure.

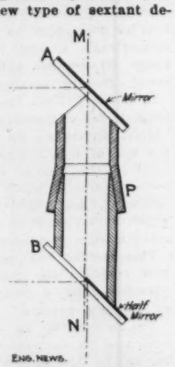


Diagram Showing Principle of the Freudenberger Sextant.

*A* is a full silvered mirror, mounted with adjusting screws to make an angle of 45° with the axis *MN* of the instrument. The mirror *A* rotates in the cone bearing *P* about the line of sight *MN* as an axis. A vernier arm *C* (not shown) is fastened to the frame of *A* and moves over a graduated arc fastened to the frame of *B*, serving to measure the angle of rotation of the mirror *A* around *MN* as an axis. *B* is a half silvered mirror mounted with adjusting screws to make an angle of 45° with the axis *MN*. In the figure the positions of the mirrors are shown for parallel rays (both mirrors reflecting an image of the horizon, which two images are brought in coincidence for the "zero" setting). If mirror *B* is kept sighted on the horizon, it is evident that with the sun at the meridian, mirror *A* will have to be rotated 90° about the axis *MN* in order to reflect the sun's image down the line of sight.

In the practical use of a sextant—sighting on the sun and the horizon, for instance—accuracy is limited by the difficulty the eye experiences in deciding when the sun's disk just touches the horizon. In the ordinary sextant, suppose that the eye can determine the coincidence of two images to within one minute of angular movement of the mirror surfaces. This means that the actual angle between the two objects can only be determined within *two* minutes of angular measure. In the new type of sextant, let the coincidence of two images be determinable again within one minute of angular movement of the mirror *A*. This means that the actual angle between the two objects can also be determined within a minute of angular measure. This possibility of increasing the accuracy of measurement is, of course, the sole advantage of the new type of sextant. The new type of sextant differs from the old in the following particulars:

The field of view in the new type of sextant appears precisely the same as in the old, except that in driving forward the vernier-arm the moving field of view travels through a vertical arc of a circle, while the moving field of view in the old sextant makes a straight vertical movement.

In locating two objects so as to make them appear in the field of view, the line of sight of the telescope is at right angles to the plane containing the two objects and the observer, i. e., the plane of the graduated arc of the instrument passes through the two objects. Vertical movements of the field of view are obtained by rotating the instrument as a whole about the line of sight of the telescope.

The ordinary type of sextant usually measures actual angles to 120° of arc or more. Since the angular movement of the mirror is only half this the sector of the graduated arc is only 60°, though graduated to read 120° directly. To secure an angular measurement of 120° in the new type of sextant, it is necessary to have a graduated sector of 120 actual degrees. Strictly speaking, the new instrument can hardly be called a sextant, since the graduated sector subtends one-third of a circle instead of one-sixth.

The adjustments of the mirrors in the new type of sextant can be accomplished most easily at sea where a horizon is always available.

To adjust for "zero" reading, the movable vernier-arm is clamped at the zero reading of the graduated arc. Mirror *A* is then adjusted until the two images of a very distant object appear in coincidence. To test whether the mirror *B* is properly adjusted, the two images should remain in coincidence independently of which part of the field of view is used. On sighting on a very distant straight line (the horizon for instance), want of proper adjustment of mirror *B* would be shown by the two horizon lines, though meeting for the "zero" reading, not forming a continuous unbroken line but being bent at the line of division of the half silvered mirror. If desirable, the graduations and arc may be extended to 180° or even to 360°, when the adjustment of the mirrors may be exact, since the two horizon lines should coincide when the vernier-arm is set at 0° and also when set at 180°. An angle and its supplement might thus be measured, in order to compensate for eccentricity errors of the graduated arc.

*Assistant Professor of Mechanical and Electrical Engineering, Delaware College, Newark, Del.

## A HIGH-SCHOOL COURSE IN COOPERATIVE INDUSTRIAL TRAINING AT FITCHBURG, MASS.*

The Fitchburg Iron Workers' Association, at a recent banquet to the members of the Fitchburg City Government and School Board, laid before them plans for an industrial school to be incorporated in the present high-school system, which were readily taken up by the City Government and have been put into operation.

The plan is in the form of an apprenticeship system whereby boys, having passed the first year in the high school, take up during the next three years a mechanical course, studying one week in the school and the following week working in the shops. A special instructor has been employed and special textbooks provided. The boys are taken in pairs by the manufacturing companies. The boy who has studied in school a week on Saturday morning at 11 o'clock goes to the shop, and learns on what particular job his partner has been working and how it is handled, so that he can come in the following Monday morning and begin work where the other boy left off. Thus he follows the shop course without necessitating instruction on the part of the shop foreman.

There have been more applications than could be taken care of the first year. At the present time all the boys are working in the shops and will continue to do so until the school opens. The school course is as follows:

FITCHBURG HIGH SCHOOL,
COOPERATIVE INDUSTRIAL COURSE.

First Year, All School Work.

| Subject. | Periods per week. |
|---|---|
| English | 4 |
| Shop mathematics | 5 |
| Mechanics | 5 |
| Freehand and mechanical drawing | 5 |
| Current events | 2 |

Second Year, School and Shop Work.

| Subject. | Periods per week. |
|---|---|
| English | 4 |
| Shop mathematics | 5 |
| Chemistry | 4 |
| Electricity and heat | 4 |
| Freehand and mechanical drawing | 8 |

Third Year, School and Shop Work.

| Subject. | Periods per week. |
|---|---|
| English | 4 |
| Shop mathematics | 4 |
| Commercial geography, business methods conditions | 4 |
| Advanced chemistry or industrial chemistry | 5 |
| Freehand and mechanical drawing | 8 |

Fourth Year, School and Shop Work.

| Subject. | Periods per week. |
|---|---|
| English | 4 |
| Civics and American history | 5 |
| Applied mathematics | 5 |
| Mechanical and freehand drawing | 8 |
| Discussion of current mechanical appliances | 2 |

The shop work consists of instruction in the ... ration of lathes, planers, drilling machines, bench ... floor work and other machine work, according to ... ability of the apprentice and pertaining to the particular branch of manufacture in the shop where he is employed. The rules and conditions of this system are:

RULES AND CONDITIONS.

Rules and conditions under which special apprentices taking the four-year cooperative industrial course at the high school of Fitchburg are received for instruction at the works of

.....

(1) The applicant for apprenticeship under this agreement must have met satisfactorily requirements for entrance to this course at the high school.

(2) The apprentice is to work for us continually, well and faithfully, under such rules and regulations as may prevail at the works of the above company, for the term of approximately 4,950 hours, commencing with the acceptance of this agreement and in such capacity and on such work as specified below:

Lathe work, planer work, drilling, bench and floor work.

And such other machine work, according to the capacity of the apprentice, as pertains to our branch of manufacturing.

This arrangement of work to be binding unless changed by mutual agreement of all parties to this contract.

(3) The apprentice shall report to this employer for work every alternate week when the high school is in session, and on all working days when the high school is not in session, except during vacation periods provided below, and he shall be paid only for actual time at such work.

(4) The apprentice is to have a vacation, without pay, of two weeks each year during the school vacation.

(5) The employer reserves the right to suspend regular work, wholly or in part, at any time it may be deemed necessary, and agrees to provide under ordinary conditions other work at the regular rate of pay, for the apprentice during such period.

(6) Should the conduct or work of the apprentice not be satisfactory to employer, he may be dismissed at any time without previous notice. The first two months of the apprentice's shop work are considered a trial time.

(7) Lost time shall be made up before the expiration of each year, at the rate of wages paid during said year, and no year of service shall commence till after all lost time by the apprentice in the preceding year shall have been fully made up.

(8) The apprentice must purchase from time to time such tools as may be required for doing rapid and accurate work.

(9) The said term of approximately 4,950 hours (three-year shop term) shall be divided into three periods as stated below, and the compensation shall be as follows, payable on regular pay days to each apprentice:

For the first period of approximately 1,650 hours, 10 cts. per hr.

For the second period of approximately 1,650 hours, 11 cts. per hr.

For the third period of approximately 1,650 hours, 12½ cts. per hr.

(10) The above wage scale shall begin the first day of July preceding the apprentice's entrance upon the first year of shop work of the high-school industrial course. The satisfactory fulfilment of the conditions of this contract leads to a diploma, to be conferred upon the apprentice by the school board of Fitchburg upon his graduation, which diploma shall bear the signature of an officer of the company with which he served his apprenticeship.

*From the American Machinist, Sept. 10, 1908.

THE TRANSMUTATION OF COPPER into lithium, which was announced as accomplished by Sir William Ramsay, is now denied by Madam Curie. It will be remembered that Ramsay subjected copper sulphate to the action of emanations from radioactive substances, and detected lithium after eliminating the copper. Madam Curie repeated these experiments, but with platinum vessels and with chemicals purified in platinum apparatus, to remove all chances of lithium contamination from glass or quartz. No evidence was found to warrant the belief that any copper was converted to lithium. A fuller abstract of the article of Madam Curie in the "Comptes Rendus" will be found in the London "Electrician" of Aug. 28.

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The maintenance of railway track in proper line, both on curves and tangents, is one of the important items in the work of maintenance-of-way. It is a work, however, that is governed by special conditions which are rarely explained to or realized by the young engineer in railway service. When a railway is in operation the track centers soon become destroyed or displaced, and the effect of the traffic is to cause the track to shift more or less. This occurs both on tangents and curves, and especially at the ends of the latter, if transition curves are not used. The lining of track may be divided into two classes, of very different character: First, the maintenance of line in detail by the section forces; and, second, the maintenance or rectification of line on a broader scale by the engineers of the maintenance-of-way department. In the first case, the track is lined at various points from time to time, as the effects of traffic or the movements of the roadbed and ballast tend to shift it from the line originally located. This work at individual points, combined with the continual disturbing influences due to traffic, etc., will in the course of a few years cause material irregularities in or deviations from the true line. These will take the form of swings or bends in tangents, kinks at the junctions of curves with tangents, and irregularities in the curves. For the easy movement of trains on curves it is very desirable that such irregularities should be eliminated or reduced.

It becomes necessary, therefore, to readjust the line at intervals, in order that the track may be restored to proper condition. This may be done for an entire division or for a long stretch of track. In doing work of this kind, however, it is not necessary to give tangents that are exactly straight or to restore curves to their exact original location. In fact, to do this would involve an amount of work and expense far beyond what would be warranted by the practical results obtained. The realinement should be done by the engineers before the section foremen are allowed to do any shifting of the track, and monuments may be set to mark the points of curves. In describing a method used in relining track, Mr. R. A. Rutledge, Resident Engineer of the Gulf, Colorado & Santa Fe Ry., pointed out that the work of a party of three engineers may save that of a track gang of 50 to 100 men (Engineering News, Nov. 1, 1906).

There is very little literature available for instruction on this important item of maintenance-of-way work, and the young engineer is likely to be impressed mainly with a sense of the necessity of restoring the exact original location. Thus much of his work will be wasted, since (as already noted) it would cost too much money to readjust the track to the line which he sets out. In view of the importance of the subject, we publish in another part of this issue an extended and careful consideration of the principles and methods involved in the relining of track as a part of the work of the maintenance-of-way engineer. We also give below a statement as to this subject from the new edition of Tratman's "Railway Track and Track Work."

In any thorough realinement of a piece of track, the transit should be used, and the track centers marked by tacks in stakes, as on new work. Short sharp swings or bends in tangents should be corrected, but long swings are not serious. In such work as this, it is not necessary to give mathematically straight tangents or exact curves. In fact, such refinement might often involve an amount and cost of work in shifting the track that would be far beyond any practical advantages, and might in many cases result in throwing the line off the existing roadbed. This is especially the case with long, easy curves, and these may have to be compounded in relining them, in order to adjust them to the existing work. The aim is to obtain practically straight tangents (free from sharp bends), and curves of such regularity that trains will ride easily upon them.

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A year ago, when the Quebec Bridge fell, Canada made up its mind instantaneously that the bridge should be built in spite of the disaster. In the thoughts of every citizen, consternation over the deplorable failure was almost at once overshadowed by a determination to see the project through at any cost. In but a few hours after the collapse, private citizens, editors and political leaders alike voiced the opinion that the work must continue. This determination has now borne its fruit in the establishment of definite means for conducting the replanning and rebuilding of the bridge. An engineering committee has been appointed, which, nominally working under the Department of Railways and Canals, is to have supreme authority to determine and direct the future work.

Now that progress is thus initiated, almost on the anniversary of the disaster, it is fitting to recall what an indispensable labor has been accomplished in the past year. We refer of course to the exhaustive investigation of the collapse of the old bridge, by the governmental commission made up of Messrs. Holgate, Kerry and Galbraith. England itself, the home of royal commissions of investigation, has never, we fancy, produced a report that could fairly be set alongside the report rendered by these engineers. Their work has been and remains of absorbing interest to engineers, and the report constitutes a permanently valuable contribution to professional knowledge. Without a thorough investigation of this kind, of course, wise planning for the resumption of the project would have been impossible.

What in some respects is the most weighty feature of that report is the picture it gives of the heterogeneous, uncentralized and non-responsible organization of the Quebec Bridge work; we might say, the utter absence of authoritative, purposeful engineering direction. The underlying causes of this state of affairs are hardly even hinted at in the report, and they need not concern us now. The facts themselves are clearly enough demonstrated again and again; we may take as sufficient proof the bald statement that the huge undertaking of erection was going on without the presence of an engineer-in-charge.

This condition, taken together with the entire past history of the project, led rather naturally to the conclusion that in the work of reconstruction the very first step must be the institution of a committee of competent bridge engineers, in absolute control. In fact, the chairman of the Commission specifically recommended this course in testifying before a committee of Parliament two months ago, adding that in his opinion no national limits should be set but the best engineers of all countries brought together as an international board to take charge of planning and constructing the bridge. The international idea was adopted by the authorities, it seems; an English engineer of high standing, a noted American designer of large bridges, and a Canadian bridge engineer of many years' practice, compose the committee.

The further course of the Quebec Bridge project, reports have it, is to be absolutely uninfluenced by what has gone before. The engineers are to start de novo, and the work, besides, will be under new auspices, under the sole authority as well as responsibility of the government of Canada. This is excellent. But great events, especially unfortunate ones, have a disagreeable way of trailing long shadows after them. It will be more than remarkable if this reconstructed and newly-started project does not find itself, at many a turn, working in the shadow of the accident of last year. We sincerely trust it may be able to emerge into light.

The task of the engineering committee is a very great one. Difficult as it would be under any circumstances, the progress and results would be certain beyond question to engage the most careful attention of the engineering world. As matters actually stand, this attention will be multiplied—by the stimulus of the intense interest awakened by the collapse of the first bridge. There will be a more anxious, a more rigid, scrutinizing of the conclusions and the designs produced by the committee. This fact renders their work correspondingly more delicate and of greater responsibility, and therefore more difficult. Judgment of fine metal will be needed. May it not be corroded by the steam rising from the ever-boiling pot of Canadian politics! May the committee accomplish its task successfully and worthily.

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*It's a poor rule that won't work both ways.*

So think the high financiers of the street railway system of New York, who, having used the transfer system to gain public favor in building up a huge railway consolidation with millions of watered stock now turn about and say that the transfer system makes dismemberment of the consolidated lines necessary. True, this is done under cover of receivers appointed by a Federal Court, but every one who understands the elements of high finance knows that these receivers are probably carrying out a policy determined in advance of their appointment, and certainly one that meets with the approval of the powers that rule.

This incident (dealt with at some length in our issue of Aug. 27, 1908) relates to the street railways of Manhattan and the Bronx, sometimes spoken of as Old New York. But while discussion of it had scarcely passed its height fresh from the press came the annual report of the Brooklyn Rapid Transit Co., a consolidation of various street railway lines. In this report "transfer dilution" of earnings is a feature, and while no talk of dismemberment of the consolidated company appears there is no mistaking a strong sentiment in favor of curtailing transfer privileges. Nor is this sort of thing confined to New York. In Philadelphia there are foreshadowings of attempts to control transfers or otherwise to cut down public benefits which were to flow from street railway consolidations and various municipal grants.

These happenings and foreshadowings give rise to the question, Is the street railway transfer system breaking down? And if it is, an added question may arise, as stated below.

The transfer question is indeed a troublesome one. It strikes us that it has been rather too much for street railway managers. While they and their anti-municipal ownership supporters have been urging the extent of the transfer system and the number of miles one can ride for a nickel in this country as an argument for the superiority of private ownership in America over municipal ownership in Great Britain, the transfer in our

larger cities has grown to enormous proportions. Although this growth has not kept pace with that of watered stock and high dividend guarantees on consolidated lines of small earning capacity, yet the increase in transfers has been so great as to make it serve as a most convenient argument for their reduction in the hopes that larger revenues would result, thus making it possible to pay dividends on enormous over-capitalization—stress, of course, being laid on the transfers and silence being maintained as to over-capitalization.

Whether the American system of nickel fares and unlimited transfers, both regardless of distance, or the British system of 1 or 2-ct. fares for small unit distances is preferable would be an interesting question for discussion, but cannot be gone into here. The point for the present moment is that American railway managers and financiers have educated their traveling public first to expect and now to demand that a nickel fare, or with tickets perhaps less than a nickel, will carry a passenger any distance in any direction, within the limits of the street railway system, no matter how large or complicated the system may be. This may have been sowing to the whirlwind, but as a man sows so shall he reap—unless he can secure the intervention of a Federal court.

Now, and finally, our street railway men and their allies, the anti-municipal ownership propagandists, having urged so long and so earnestly the transfer system as an argument in favor of private ownership may find another and different illustration of the saying that it's a poor rule that won't work both ways. That is, if the railway men break down the transfer system to suit their own ends, placing those ends above and beyond the public interest, then they may find to their sorrow that the transfer system will be popularly regarded as possible only under public ownership, instead of being the strong argument for private ownership of which so much has been made. The chief justification for such an argument will, of course, be the claim that the street railway system of a city or a group of cities and towns must, like the postal system of a nation, be considered as a whole, and the nickel fare, like the 2-ct. stamp, guarantee conveyance to any point on the system. If private companies will continue to act on a theory which they have themselves taught and finally brought into practice, they must expect to take the consequences, which may perhaps be a choice of: (1) financial reorganization on such a basis as to make universal transfers possible, (2) a scaling of minimum fares, or (3) as a last resort, municipal ownership.

## A HIGH-SCHOOL INDUSTRIAL COURSE.

Cooperative education, the fixed alternation of class-room instruction and practical shop work, as a development of engineering education, has already been discussed in this journal.* A few enthusiastic advocates of this system urge it as the sure remedy for all the troubles in present-day technical instruction. We have previously† expressed the belief that the cooperative system would find an important place in the field, particularly for those students who have the ambition and the ability, but not the means, for undertaking an engineering course.

Until a few weeks ago the cooperative plan had been considered for colleges and technical schools only; now it is seriously proposed as a branch of public high-school instruction. In another part of this issue we have reprinted an interesting and suggestive article on the general plan to be followed at Fitchburg, Mass. The boys who select this course will follow a specialized line of study for four years and, during the last three of these years, school periods of one week's duration will alternate with apprentice work in some shop of that city. The whole vacations, with the exception of two weeks in the summer, are to be given up to shop work.

*See article by Dr. Herman Schneider, "Two Years of the Cooperative Engineering Courses at the University of Cincinnati," Eng. News, July 9, 1908.

†"New Things in Engineering Education," Eng. News, July 9, 1908.

At first this plan may impress many as excellent, but a study of the details leads to the belief that the great benefits will come to the manufacturers, who proposed the scheme, and that the students will receive only a minor benefit and this, too, at the cost of advantages forever lost. It might also seem, at first, as though this would be a good college-preparatory course for a boy inclined toward engineering work. Such an impression, however, is soon lost. For the boy who will go to college and for the boy who will not, much of that which is to be gained, through this proposed course, can be as well secured later. All of that which is sacrificed can be gained nowhere else so well as in school.

It is a principle recognized by an increasing number of educators that there should be taught in school first those things which can be secured elsewhere, or afterwards, not at all or only imperfectly. This is a principle which, it is widely believed, will, if wisely followed, yield the best results in the long run. It is an expedient policy, many times, to so modify the application of this principle that students may be enabled to do commercial work at graduation and thus be in a position to earn a better living at the start of their actual career. Such a policy needs no defense, but it should be more often borne in mind, than possibly has been the case, that the lack of those studies sacrificed to acquire certain commercial practice will sooner or later act as a handicap to the graduate. Some compromise between the principle and the policy is usually necessary, but no student, in high school or college, should be deliberately led to make greater concessions to immediate circumstances than are imperative.

It strikes us that this Fitchburg course is arranged as an expedient measure that will draw in more boys who do not need to sacrifice the greater benefits of a typical high-school course than it will of those who must earn while they study. The boy who intends to become a mechanic learns nothing of any other language than his mother tongue. The history of all nations but his own is a sealed book. Literature and art are but names. This boy, in time, may become an expert mechanic, a foreman, a superintendent, a maker of dividends for his employers, but he must stop short of what he might have been. The lack of certain influences at a critical period of his life may be seen later in an intolerance and a lack of sympathy that is a real handicap in handling men and in getting the most pleasure out of life. Some may ask for the interest a mechanic has for such "culture subjects," but such an enquirer would be one who was not familiar with the older New England mechanics and the degree to which they enjoy travel, good literature, and artistic work. Such an enquirer would be ignorant of the diminished tendencies toward such enjoyments in the younger men who are replacing the older ones as these retire to their cottages and fields.

It may be argued that the Fitchburg course, as proposed, will induce boys to remain in school and to work there as they would not under the old conditions. It is probably true that cooperative courses would keep many from dropping out, but this is only an added reason why the course should be made liberal instead of narrow. It has been said that most boys do not take kindly to high-school curricula. A glance at the Fitchburg schedule does not reassure one that subjects easily grasped or especially attractice have been included. Mechanics, shop mathematics, advanced chemistry and physics are scarcely subjects that would fit boys 15 years old. The course seems monotonous for youngsters who cannot be expected to have habits of concentrated attention. There is then danger of soon driving away just those boys whom it was hoped to hold. It would seem possible that demonstrations of elementary science, descriptive and interesting arrangements of history, live literature and simple art would do more to hold these boys in school. These require good teachers, without the proverbial and pedantic inclinations of marshaling formidable facts, figures and dates. It seems feasible to arouse, in some such way, the interest of boys who will become mechanics and to so direct their inclinations toward the sciences, literature and various fine arts that they may later have beneficial relaxation after labor.

It is to be noted that this course was apparently suggested by the manufacturers, whom we may suppose are in need of a supply of promising young mechanics. Perhaps these men have insisted that only certain subjects should be included in this course of study. If this is so, it bears out a remark previously made* on the tendency toward over-specialization in technical schools.

The tendency toward specialization in education is due rather to parents and trustees and employers than to the sound judgment of our best educators.

For the boy who has the ambition to study engineering in college, a cooperative course needs only one excuse—the determination of his fitness. The faculties of engineering schools are seeking a just way of early eliminating the unfit and those who are attracted by the false hope of wealth rather than the love of the work. It is not necessary or even desirable to train the prospective engineering students as complete mechanics. It is, however, almost necessary to eliminate false ideas of the inherent grandeur of engineering work, and to give the boys such taste of manual training that the bent of their minds may be accurately determined. With such a limited field of use of the cooperative scheme in preparatory courses there is no need that they should be highly specialized. For a boy planning to enter college, even if this Fitchburg course were acceptable preparation with any faculty, a very doubtful condition, then the narrowing influence of the proposed curriculum would be strengthened all during the college course. As a student the boy might excel in mathematics and in his grasp of some natural science, but the very training which might help at first would only retard later if a man of broad ideas was needed.

So far we have mentioned only the probable effect of the proposed course in molding a boy's future. But it has a more immediate and no less important effect which seems to have been overlooked. It may well be asked if it can be justifiable to take a boy, 15 or 16 years old and to work him as the course provides with only two weeks respite each year. Will his physique show no sign of the lack of fresh air, sunshine and pleasure during the years of adolescence. Moreover, would any of the supporters of such a plan wish to blot out their own memories of base-ball and foot-ball games, of fishing and hunting excursions and all the rest that come from uninterrupted school and vacation days? Is it fair, then, unnecessarily so to lead a boy that his youthful memories are all of hard lessons, dusty shops, and aching muscles?

To give the boys some insight into the broader school subjects—languages, literature, art and nature; to arrange the shop hours so that the boys will not be physically over-strained and so that they may still have some of the priceless associations of school and vacation days; to allow the desired rudimentary technical work with all the rest is truly a difficult task. If such elementary technical training cannot be obtained without great sacrifice of the stated school advantages, then it is not worth while, as a high-school course. But we believe that by judicious compromise a commendable scheme can be worked out. It must not be expected, however, that the manufacturers will favorably regard it, for the balance of advantage will not be greatly in their favor.

*"Some New Things in Engineering Education," Eng. News, July 9, 1908.

## LETTERS TO THE EDITOR.

### The Proposed Membership Amendments to the Constitution of the American Society of Civil Engineers.

Sir: As the originator of an amendment to the constitution of the American Society of Civil Engineers which would leave the election of new members with the membership, where it now is, and which is yet to be sent out for letter-ballot, I was much pleased with Mr. Samuel Whinery's letter in Engineering News of Sept. 10. The object of this letter is to recall to members of the American Society of Civil Engineers certain his-

terical facts bearing on the question now before them, which will enable them to vote understandingly.

(1) For an account of the first discussion upon the amendments now to be voted on, see the report of the Annual Meeting of Jan. 15, 1908, p. 65 of the Proceedings for 1908.

(2) The following table shows the percentages of votes cast, necessary to exclude, as practiced by and constitutionally prescribed for some well-known clubs and societies:

| | | |
|---|---|---|
| Boston Society of Civil Engineers | over | 1/3 |
| New England Water Works Association | " | 1/3 |
| Society for Promoting Engineering Education | " | 1/4 |
| Institution of Civil Engineers of London | " | 1/5 |
| Century Association of New York | " | 1/5 |
| American Society of Civil Engineers as now constituted: 20 votes out of an average of votes cast of 458, or | " | 1/23 |

It has not yet clearly appeared in the reports and discussion why a rule based on number of votes cast, say 1/5 the votes cast, which serves well in other societies, would not serve equally well for the American Society of Civil Engineers.

(3) It is extremely doubtful if the committee, which reported at Denver, was properly constituted, inasmuch as it contained one member who was thus put in a position naturally to report in favor of an amendment to the constitution which he had himself proposed; and to report against another such amendment, designed to take its place, the one yet to go out to letter-ballot. Also, as the mover of the resolution of Jan. 5, 1908, to refer to a committee, to be appointed by the chair, I am in position to state that this Denver committee did not have referred to it on Jan. 15 something that was not written until several months later, viz., the amendment yet to go to letter-ballot; but on which, nevertheless, they also reported, causing it to be put in the shape yet to be sent to letter-ballot. The change thus made substitutes for 20% of all the votes cast, the figure of 1% of the corporate membership.

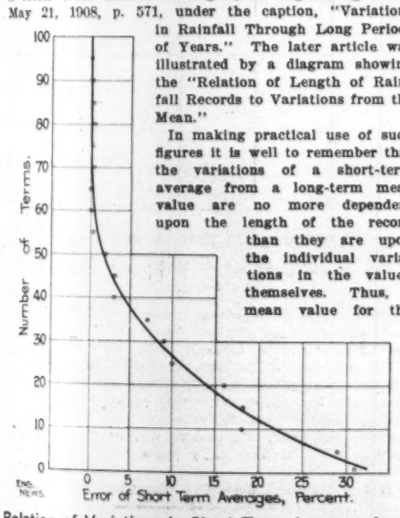
(4) Speaking for myself, I hope the ballot now called for will be decided in the negative; and that when the amendment yet to be sent to letter-ballot will come before the society, *as it must come in any event*, that it will be adopted, notwithstanding it will thus appear, as I believe, in deteriorated form. Even as thus changed, I believe it to be more worthy of an American Society of Civil Engineers than the amendment now to be voted on.

Clemens Herschel.

2 Wall St., New York City, Sept. 12, 1908.

## Length of Time Required to Determine Rainfall or Stream Flow with a Given Percentage of Error.

Sir: The length of time required for determining mean values of rainfall or stream flow within a given percentage of error was touched upon in an article by Mr. John C. Hoyt, Assoc. M. Am. Soc. C. E., entitled "Length of Records Necessary for Determining Stream Flow," in Engineering News, for April 23, 1908; also in a letter from Clinton L. Bogert, in Engineering News, May 21, 1908, p. 571, under the caption, "Variations in Rainfall Through Long Periods of Years." The later article was illustrated by a diagram showing the "Relation of Length of Rainfall Records to Variations from the Mean."




Relation of Variations in Short Term Averages from a Long Term Mean, for Numbers of at Least Four Figures, Each Chosen at Random.

In making practical use of such figures it is well to remember that the variations of a short-term average from a long-term mean value are no more dependent upon the length of the record than they are upon the individual variations in the values themselves. Thus, a mean value for the runoff from uniformly flowing streams, such as the Deschutes in Oregon or the Niobrara in Nebraska (the ratio of maximum to minimum discharge for both streams is about four), differing not more than 5% from the normal, can safely be taken from five or six years' records, while a mean value for the Tennessee River, for example, within 5% of the normal, would require 25 or more years.

The convergence towards a mean value, as shown by the diagram accompanying Mr. Bogert's letter, is a simple property of numbers and not necessarily a phenomena of rainfall nor of stream flow. To more fully illustrate this point I have picked at random 100 numbers of at least four figures each. In order to insure as miscellaneous a selection of numbers as possible I took the last four figures as they come in the columns of a 7-place logarithm table. Of these 100 numbers the highest was 9,570 and the lowest 249, while the mean was 5,193. The average of the first 5 was found, then of the 10, then the 15, and so on. The percentage of variation from the 100-number mean of each of the 20 averages thus found are plotted on the accompanying diagram. Fifty numbers in this case gave a value within less than 2% of the mean, which is even better than fifty years' records would give by Mr. Bogert's diagram, although his averages converge a little more rapidly than mine.

Very truly yours,

J. C. Stevens,
District Engineer, U. S. Geological Survey.

Portland, Ore., Aug. 28, 1908.

## The Experiments on the Ozone Treatment of Croton Water, New York City.

Sir: I have read, with great interest, the article which appeared in the Engineering News of Nov. 21, 1907, concerning Mr. de Varona's report on the filtration of the Croton waters for the supply of New York.

My attention specially went to the bad results obtained in the trials of water purification by the ozone system. Having specially studied this system of late, I beg to offer the following criticisms on the modus operandi of these experiments, the failure of which, in my opinion, is solely attributable to defective arrangements, purification by ozonization having given perfect results in all the latest experiments and practical applications of the system recently carried out in Europe.

I must first note that the Blanken ozonizer uses an alternating current of 10,000 volts at 60 periods and that the ozonized air was sent into a tank, 38 ft. high and 22 ins. diameter, in which it entered through a strainer. This way of bringing the ozone in contact with the water was the first to be tried in Europe, but had to be abandoned and, to it, owing to the poor results achieved, is due the discredit, among engineers and sanitarians, under which the process of water ozonization is still held. The causes of such failures are, in the present state of our knowledge, self-evident, for one can blow through a mass of contaminated water an almost unlimited quantity of ozone without ever achieving sterilization, because the layers of water which do not come into immediate contact with the gas work against the success of the process. In order to prolong the contact between water and ozone it is necessary to increase the height of the liquid in the tank; this would require ozone to be sent through the water at high pressure, as was done in the Croton experiments. But any such high pressure tends to destroy the ozone, not to mention the difficulties for the design of a suitable pump for the storage and compression of this highly oxidizing gas. The system adopted for the Croton experiments is therefore doubly defective: (1) owing to insufficient contact between ozone and water; (2) by the destruction of the gas through compression.

In his report, Mr. de Varona duly mentions the quantity of ozone produced per kilowatt-hour, but does not mention the degree of concentration; that is to say, the amount of ozone in a given quantity of air. Concentration is of primary importance in the microbicide efficiency of ozonization. If concentration falls below one or even two milligrams per liter of air, sterilization will be incomplete, no matter what the quantity of ozonized air may be; it is just similar to the quantity of carbonic acid in air which at 50% concentration will kill a man, while remaining comparatively harmless at, say, 5% concentration. Micro-organisms present in water and subjected to ozonization with weak concentration are merely aerated, perhaps even vivified, but never destroyed; once out of the ozonizing tank, they will resume their former vitality.

Ozone must therefore be produced at a high degree of concentration, which requirement precludes the use of apparatus with an output of weak density, but ozone is preeminently an oxidizing and unstable gas which can only be compressed if its degree of concentration is weak; it would decompose under pressure and would, if concentrated, attack the metal in the pumps, decompose the oil of the lubricants, etc.

The conclusion of all this is that, in order to avoid all these inconveniences, the ozone as used for the Croton experiments must have been under weak concentration, which would account for the poor results obtained.

I also notice that the air was dried by cooling, which implies a refrigerating installation, complicates the operation of the plant and increases the chances of unforeseen stoppages. It would have been much simpler to dry the air by the use of lime, a process which has proved eminently successful wherever tried.

Further details would greatly increase the length of this letter. I will therefore only mention, in support of my statements, the good results obtained at the waterworks for Cosne (France) where ozonization has been in practical use now already for three years.

In this installation the water is drawn directly through a thick layer of gravel and fine sand from the River Loire, and then raised to the top of the ozonizing tank wherein it dribbles on and through layers of pebbles which fill this tank. The air is first dried through lime and then charged with ozone at a concentration of 6 to 6½ milligrams of ozone per liter. In this state of concentration, the ozonized air is led into the tank, from the bottom; i. e., in a direction contrary to that of the flowing water. This contrivance assures perfect contact between the ozonized air and water.

The results of this system, which can be found in a report drawn up by Dr. Roux, Director of the Pasteur Institute of Paris, and Dr. Cornil, are excellent. The trials carried out by the above two authorities, with all possible guarantees, have conclusively shown that water from the River Loire which contained 4,000 bacteria per c. s. after filtration through sand filters, is found to contain only one bacterium after treatment in the ozonizing plant.

I feel confident that, had the Croton experiments been conducted in the same manner and not under the defective conditions exposed above, the results would have proved quite as satisfactory.

Yours faithfully,

L. R. De la Mahotiere, City Engineer.

Bangkok, Siam, June 19, 1908. Bangkok (Siam).

[Proof of the foregoing letter having been submitted to Mr. de Varona he has replied as follows.—Ed.]

Sir: The tests referred to by Mr. L. R. De la Mahotiere were made upon a patented apparatus which the owners installed and operated at their expense, expecting and assuring us, when they secured permission to install their plant, that by their method they would readily obtain 85 grams of ozone per KW.-hr., thus bringing the cost of the process within practical limits, and that they would also secure continuity of action and reliability of operation. We therefore had no responsibility for the installation of the plant nor any voice in modifying its construction or operation, whatever our own ideas might be with regard to some of the details.

Now as to the statements in the letter under consideration: The concentration of the ozone from this apparatus was about 1 gram per cu. m., or about one-sixth the concentration given in the Bangkok letter. The higher concentration could not be obtained with this apparatus. Such increased concentration would undoubtedly be more efficient, but also at an increased expense.

The system described by the City Engineer of Bangkok necessitates the dribbling of the water under treatment through tanks of pebbles. The area necessary for this arrangement would be enormous to care for the Croton supply and such a method would be expensive and impracticable for so large an amount of water.

In all the tests made, a measurable amount of ozone escaped from the top of the tower, which, when the amount taken up by the passing water is considered, shows that certainly not a material amount was destroyed by the pressure to which it was subjected.

When the system tried was operating properly, efficient results were obtained, but the apparatus did not work continuously, owing to the frequent disarrangement of the delicate adjustments.

In addition to the continuity and reliability of operation, the expense of the process was the main point to be considered and this would undoubtedly be increased by the use of lime instead of a refrigerating apparatus for the removal of the moisture from the air to be ozonized. The constant replacing of the slacked lime must also be considered.

Since the greatest objection to the ozone treatment with the apparatus tried was that of expense and that of interruption and since the method outlined in the letter under discussion greatly increases the first cost in the area of plant, at least, and probably in the operation charges, and since it does not outline a method of overcoming the interruptions, its advantages are not evident.

The merits of ozone as an efficient purifier are too well known to need discussion, but for the reasons above given, its use is by no means general. There is not, in this country, as far as I am aware, a single plant in operation in any of our cities, at least not any plant of importance; while the small plants established in Holland and one or two cities in Germany and the experimental tests for some time conducted in Paris, show that the processes hitherto in use have not proved satisfactory and to such a point that, as I learn on the highest authority, in a small town in Germany the establishment of the ozone plant proved so embarrassing to the eminent Chief Engineer who advocated it, that it led to his resignation, and the plant is not now used regularly.

I regret not to be familiar with the plant installed at Cosne, France, to which Mr. De la Mahotiere refers, and to be therefore unable to discuss it.

I. M. de Varona,
Chief Engineer.

Department of Water Supply, Gas and Electricity, New York City, Sept. 12, 1908.

### Effect of the Recent Southern Floods on a Timber Trestle.

Sir: In the accompanying view is shown the wreck of the bridge of the Seaboard Air Line Ry. over the Savannah River near here, caused by the floods after the recent heavy rains in this section. Just above the bridge the river divides, leaving a small island. The part of

TIMBER TRESTLE ACROSS SAVANNAH RIVER, WASHED AWAY BY FLOODS OF AUGUST 24-25.

the bridge washed away, about 400 ft. long, was all wood trestle and on the island. The water reached the height of the stone piers.

Yours very truly,
W. L. Hemphill.

Abbeville, S. C., Sept 1, 1908.

### Minimum Rivet Pitch in Plate-Girder Flanges.

Sir: Referring to C. H. Wood's article in Engineering News of Aug. 6 on "Minimum Rivet Pitch in Plate-Girder Flanges," the following supplementary remarks are offered. The web-plate might fail horizontally as shown in Fig. 1 herewith, under the load of 1½ rivets on a distance $(2p - d)$, or as shown in Fig. 2 by the

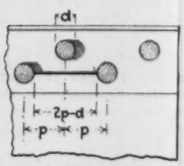



Fig 1

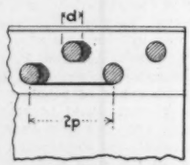



Fig. 2.

load of 2 rivets on a distance $2p$, the former in case $p$ is less than $2d$ and the latter if $p$ is greater than $2d$. Let

$p$ = minimum alternate rivet pitch.
$s$ = maximum allowable rivet shear.
$2s$ = maximum allowable rivet bearing.
$t$ = thickness of web-plate.
$d$ = diameter of rivet.

If the bearing value governs in determining the rivet pitch we have in Fig. 1,

$$[2p - (d + 1/16)]\ t\ s = 1\tfrac{1}{2} \times 2 \times s \times t\ d;$$

whence

$$p = 2d + 1/32.$$

In Fig. 2,

$$2\ p\ t\ s = 2 \times 2s \times t\ d;$$

whence

$$p = 2d.$$

If rivet shear governs we have

$$[2p - (d + 1/16)]\ t\ s = 1\tfrac{1}{2} \times 2 \times \tfrac{1}{4}\pi\ d^2 s$$

whence

$$p = 1.18\ d^2/t + \tfrac{1}{16}d + 1/32, \text{ or, say, } 1.2\ d^2/t + d/2.$$

In case of a deck plate-girder the pitch may be taken considerably less than given by these formulas because the shear represented by, say, the first four rivets will be taken up by the web over a distance equal to the length occupied by the four rivets plus the width of the end bearing, as the web shear decreases from the inner edge of the end bearing to the outer edge and is always less than the end reaction.

Olaf Evensen.

Montreal, P. Q., Aug. 25, 1908.

### Concrete Block in Earthquake Countries.

Sir: I have read with much interest the communication from Mr. H. M. Doubleday, in your issue of Aug. 20, 1908, p. 212, on the use of concrete block in earthquake countries. Mr. Doubleday seems to invite criticism, and although distance may make this communication tardy, I venture to submit it in the interests of the profession.

Reinforced concrete is not an imitation stone, as many aver, simply because it is used to a large extent where stone has heretofore been used, any more than glass is an imitation of oiled paper, or steel an imitation of cast iron. But concrete blocks *are an imitation* of terra cotta blocks and brick. Engineering made a great stride to the front when it adopted reinforced concrete, and now to cheapen concrete by reverting to plain blocks is a dangerous and unwarranted retrogression.

The lack of published suggestions as to block construction to meet conditions of earthquake and hurricane is in itself evidence of the awe in which these terrible natural forces are held. Nothing should be employed to withstand such forces except the very best forms of construction. The earthquakes of San Francisco and Kingston have demonstrated the ability of reinforced concrete successfully to withstand the terrific stresses set up in a structure by such forces.

Why, then, at the risk of many valuable human lives, perform such a costly experiment as block construction would surely be?

Brick and stone structures succumbed in these disasters just cited, and brick and stone are nothing but blocks. It was not the fault of the "poor mortar," which usually has to bear the brunt of criticism, but the fault was inherent in the form of construction. Blocks cannot be tied together adequately, save at enormous expense, while reinforced concrete is thoroughly tied together (if properly designed) and the minimum amount of steel can be placed to the maximum of advantage, in a less amount of the same material as would be employed in concrete block construction.

It is hard to understand why the universal principle, "You can't get something for nothing," is overlooked by rational beings. A wall of good concrete will stand no more direct pressure if of blocks than if a solid monolith. A hollow block wall, then, to be as strong as a solid monolithic wall in direct pressure must be thicker, since the hollow spaces must take up a certain amount of room. Mr. Doubleday would then add a filling in these spaces. The blocks being cured and shrunk, the filling would shrink at leisure away from its share of the work, if it were counted on to take load.

But far more important than direct load resistance in an earthquake or hurricane country is the resistance to flexure in its various forms which is supplied by reinforced concrete, and not at all by block construction, however well it may be strapped and tied together.

Argument No. 5, presented by Mr. Doubleday contains the principle upon which all good construction is based, namely, that "A chain is only as strong as the weakest link." His statement that the walls will be as strong as the blocks themselves is very true. But how strong will these blocks be after the gyratory action set up by the shocks, has twisted and sheared off all the interlocking corners of the brittle blocks? Better reduce the cost of forms by casting plain blocks at the start. The wall will be just as weak.

Having viewed the ruins of Kingston, I am impressed more than ever before with the wonderful security that has been placed within the reach of humanity against one of natures most powerful destructive forces. It is beyond comprehension why the lives of the trusting thousands should be placed in jeopardy by allowing a few men to experiment with an imitation of those building materials which have been proved by several terrible examples to be as unsafe before earthquake shocks as a lamb is under a lion's paw.

Laws are remiss in ignoring concrete block construction—they should condemn it.

Yours truly, H. F. Tucker.

Culebra, Canal Zone, Aug. 31, 1908.

[While agreeing with our correspondent that reinforced concrete is superior to concrete block in earthquake countries, we cannot agree with his wholesale condemnation of the concrete block in construction. There are places and conditions, too obvious to enumerate, where the block is an ideal form, provided some care is taken in the production of the units and the laws of architecture are observed. We fail to see how concrete blocks are more of "an imitation of terra-cotta blocks and brick" than terra-cotta blocks and brick are imitations of cut-stone. The only similarity is in the general shape which is merely a result of a like system of construction.—Ed.]

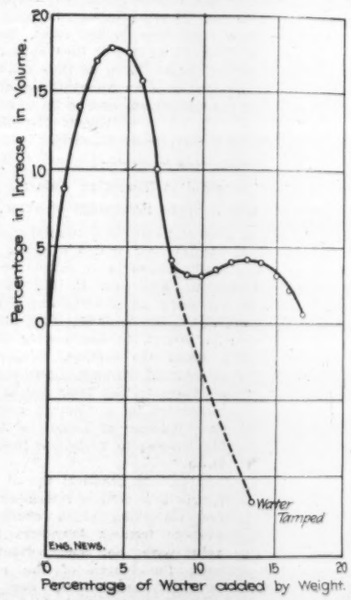
### The Effect of Moisture on the Bulk of Dry Sand.

Sir: That moist sand occupies more than the same amount does when dry is a fact known to most engineers [see letter of Mr. H. Winfreth, Eng. News, Aug. 20, 1908, p. 211]. But that fact might have any bearing on practical work seldom considered.

Some time ago while gathering cost data, I noticed what at first glance seemed to be an error in observation. In mixing a rather large amount of Portland cement mortar the following quantities were used: 10.2 cu. ft. of sand, 330 lbs. or 3.2 cu. ft. of Portland cement and enough water to make a thin mortar. The quantity of mortar obtained was only 9.4 cu. ft. The cement was weighed on a Fairbanks scales and the sand was measured in specially constructed measuring boxes, which had previously been checked by both the engineer and the contractor's representative. As over 80 cu. yds. of this kind of mortar was used and the apparent discrepancy between the amount of raw materials and mixed mortar was noted and investigated in the early stages of the work there can be no question, about the reliability of these figures.

The sand used was bank sand obtained near Coshocton, Ohio, being locally known as Coshocton sand. An analysis of a sample gave the following results: Specific gravity 2.58, effective size 0.42 mm., 60% smaller than 2.9 mm., uniformity coefficient 6.4. From this it can be seen that it is a course sand a considerable quantity being larger than ¼-in. The sand as delivered on the works contained about 5% of moisture by weight.

Experiments in regard to the increase in volume of sand for various percentages of moisture gave the curve shown in the accompanying cut. The sand was measured loose and the percentages of water to dry sand were taken by weight. It should be noted in this curve that when the percentage of water added to the sand became more than 8%, considerable difficulty was experienced in obtaining an even mixture. A great number




Curve Showing Effect of Moisture on Bulk of Dry Sand.

of minute air bubbles were formed which would very seriously affect the results. The dotted line would, in the writer's opinion, be more nearly correct.

To determine if the gain in volume on account of moisture was excessively large for Coshocton sand, experiments were made with various other sands. The results indicate that the finer the sand and the more uniform the grains the greater will be the increase in volume.

Very truly yours,
A. Stellhorn.

1231 S. High St., Columbus, Ohio, Aug. 30, 1908.

### Notes and Queries.

In regard to the peculiar highway bridge described by Mr. F. M. Goodhue in our issue of Aug. 27, p. 237, Mr. Charles E. Bowron of Los Angeles, Cal., writes as follows:

I have recently seen a similar bridge on the Starkville road out of Trinidad, Colo., with the difference that the top chords and end posts were each of two pieces of pipe horizontally side by side and these fitted snugly into castings at the joints and abutments. This style of construction is similar to that used in a well-known tank tower and would appear to have some advantages over bending the pipe at the joints.

Mr. Henry [illegible] Gray, Engineer of the Railroad Commission of Washington, has called our attention to a slight arithmetical error in the computations for velocities given in the last column of p. 226, Aug. 27, 1908, in the article entitled "A [illegible]-Mile Pipe-Line Water Distribution System on the El Paso & Southwestern Ry." The 19th and 20th lines of that column should be

$$y = 5{,}328 \quad y = 134{,}800$$
$$y = 3.816, \text{ and } x = 9{,}768.$$

The values of $x$ and $y$ as given were $y = 3.805$ and $x = 9.74$.

Our attention has been called to the fact that the method of solving an exponential equation by means of parallel coordinates, or the so-called d'Ocagne method of isopleth points, has appeared in our columns several times previous to the article by Mr. Richard Muller (Sept. 3, 1908, p. 250), entitled "D'Ocagne's Method of Isoplethe Points Applied to the Francis Weir Formula." These previous articles are: "A Diagram for Computing the Flow of Water over Weirs," Andrew P. Anderson, Feb. 8, 1906, p. 157; "A Floor-Beam Scale in Parallel Coordinates," Lucien A. Picolet, May 31, 1906, p. 612, and "Three-Scale Logarithmic Computing Paper for Solving Formulas," S. Jay Teller, Dec. 19, 1907, p. 682.

Some changes in the first paragraph of the article on the progress of the Roosevelt Dam, published in our issue of Sept. 10, were made necessary after a portion of the edition for the date named had been printed. This was due to an unavoidable delay in the receipt of proof from the author. In a portion of the edition, and also in the first note on the editorial page of the issue named, some figures giving dimensions of the dam appeared, which were taken from a statement printed in the July issue of the "Reclamation Record," which is the official organ of the U. S. Reclamation Service. Later figures, as given by Mr. Smith, the author of the article in question, give the total height of the dam as 276 instead of 284 ft. The length of the dam, which was reported in July as 1,080 ft., includes the two spillways. Deducting these, the Roosevelt Dam has a total length of about 700 ft. Of the total height, 240 ft. is above the original low-water level of the river, and 36 ft. is below that level. The flow line as proposed will be at Elev. 220, the original water level being taken as 0. The capacity of the reservoir at the flow line, as correctly stated in previous issues, will be 1,284,000 acre-ft., or 418,000,000,000 gals.

## PRECISE LEVEL OPERATIONS ON THE LOS ANGELES AQUEDUCT.

By CHAS. H. LEE,* Jun. Am. Soc. C. E.

The use of levels of precision in the United States has been almost entirely limited, in the past, to work carried on by various Government organizations, such as the U. S. Engineer Corps and U. S. Geological Surveys, where the greatest

Fig. 1. Bausch, Lomb & Saegmuller Precise Prism Level, Used on Los Angeles Aqueduct Survey.

accuracy was necessary. The precise level is regarded by many engineers as an unnecessarily complicated instrument, requiring a specially trained and qualified observer, and at best slow and costly to operate. The satisfactory use of a precise level in running levels for location and construction work under rather difficult field conditions should therefore be of interest to the profession.†

The project of the City of Los Angeles for obtaining an additional water supply from the Owens River Valley involves the construction of about 235 miles of aqueduct, a large part of which is concrete-lined conduit and tunnel having hydraulic grades varying from .00035 to .002. The great length of the aqueduct, the light grades and the large amount of money involved in its construction, led to a decision on the part of the engineers in charge, Mr. Wm. Mulholland, M. Am. Soc. C. E., Chief Engineer, and Mr. J. B. Lippincott, M. Am. Soc. C. E., his assistant, to establish permanent elevations near grade by precise methods. The work was carried on under the immediate charge of the writer, during the ten months from February to November, inclusive, 1907, and involved the running of 525 miles of single-line levels and the establishment of 136 permanent benchmarks.

FIG. 3. WIND SHIELD AND SUN SHADE USED ON LOS ANGELES AQUEDUCT SURVEY.

The instrument chosen was that which has been used with such great success by the U. S. Geological and U. S. Coast & Geodetic surveys since 1900 (see Fig. 1). A complete description of this instrument, by John F. Hayford, will be found in Engineering News for July 2, 1903, and it will be sufficient here to say that Mr. Hayford's statements regarding the accuracy, speed and reliability of this type of instrument are fully borne out by our own experience.

The standard U. S. G. S. yard rod (Fig. 2) for precise work was used. This is a 12-ft. rod, non-extensible, self-reading, and made of white pine impregnated with paraffin. Graduations are in terms of the yard and consist of tenths and hundredths, the former being numbered and the latter painted in small black and white squares on either side of the center line of the front face. Fine lines engraved on silver plugs set into the wood at intervals along the face of the rod furnish an accurate graduation for reference. Each yard has a distinctive color. The reasons for using the yard as a unit is apparent when it is remembered that each reading is the mean of three wire observations. It thus requires nothing but an addition to obtain a mean reading in feet. Furthermore, by using the yard the chance of error in reading the unit is reduced, and it is possible to use a simple color scheme as a check. Also the smallest subdivision is of such a size that estimation of the tenth part is easily and accurately made by eye. The bottom of the rod is fitted with a cylindrical pin about 1 in. in diameter and 1½ ins. long. Turning pins were made of tool steel about 11 ins. long, tapered to a blunt point from a diameter of 1 in. The head was enlarged to a diameter of 1¾ ins. and a cup-shaped depression 1 in. in diameter was turned out of the flat top to receive the bottom of the rod. Oak mallets were used in driving the pins. This type of pin gave great satisfaction and is especially adapted for use in loose, sandy soil, or in windy weather.

Benchmarks were designed after the pattern of the U. S. G. S. standard. Elevations were stamped on to .001-ft. These benches were driven into holes drilled in rock and surrounded with neat Portland cement, or a mixture of litharge and glycerine. The latter gave the best results, as it was found that the great heat on the desert evaporated the water from cement before setting was completed. Benches were set above grade and spaced about 2½ miles in open country. In mountain divisions they were located at tunnel portals and ends of siphons. The general procedure was to establish a main control line along highways and lines of easy travel adjacent to the aqueduct and then to establish bench elevations on grade by means of circuits closing on the main control, or by short spur lines.

All leveling was done by the single rodding method, with two rodmen, each rod being used alternately as a foresight and backsight. This method gave an increase of more than 30% in speed over that possible with one rod and considerably increased the accuracy by making it possible to read fore and backsights almost simultaneously. The instructions followed in carrying out the work were essentially those prescribed by the U. S. Geological Survey in precise work and were as follows:

(1) The maximum length of sight permissible is 300 ft., and this maximum is to be attained only under the most favorable conditions. (An exception to this rule was made when the line of sight did not approach the ground nearer than three or four times the length of the instrument throughout the major part of both back and fore sight.)

(2) No sight on a low rod shall be taken where the line of sight approaches nearer than 1½ ft. to the ground surface. (An exception was made in the case of steep slopes where sights were short.)

(3) The level must be shaded by an umbrella during observations and by a cloth hood when carried between stations.

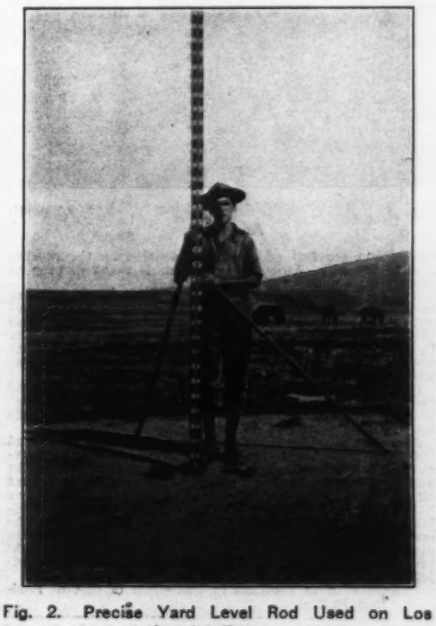


Fig. 2. Precise Yard Level Rod Used on Los Angeles Survey.
(Showing Method of Steadying Rod in Wind.)

*Assistant Engineer Los Angeles Aqueduct, Independence, Cal.

†Readers of this article may be interested in reading one published in our issue of Feb. 20, 1908, entitled "Bench Level Operations on the Catskill Aqueduct."—Board of Water Supply, New York City.—Ed.]

(4) Fore and back sights shall be kept as nearly equal as possible. The maximum allowable difference between a back and the corresponding fore sight is 33 ft. The continuous sum of lengths of back and fore sights for a course between benchmarks must not be allowed to differ by more than 66 ft.

(5) Precise level lines must consist of lines run independently in both the forward and backward direction. The allowable error in feet is 0.017 (distance between benchmarks in miles) and when this limit is exceeded on any course the forward or backward measure is to be repeated until a pair run in opposite directions is obtained between which the divergence falls within that limit. The observer should secure as much difference of atmospheric conditions between the measurements as is possible without materially delaying the work for that purpose.

(6) The program at each set-up is as follows: After the tripod is firmly set and the clamp screws tightened, level approximately by the circular level (which has been adjusted by comparison with the long level). Point instrument towards rod, and clamp; bring level bubble to center of tube by means of the micrometer screw. Read on rod, taking first the color initials for the lesser and greater extreme readings; second, yards and tenths for each wire, taking smallest reading first; third, hundredths and estimated thousandths. Before level is moved recorder should first notice that color agrees with yard readings; second, compute the two thread intervals and if their ratio differs by more than 1% from the true ratio, the levelman must repeat the readings; third, compute the mean reading in feet by summation and test units and tenths by mentally multiplying the middle reading by three. Also the observer should test the mean reading in feet by observing the middle wire

Fig. 4. Rocky Hillside on Line of Los Angeles Aqueduct.

reading on the feet and tenth graduation on the reverse side of the rod. After an agreement is reached, proceed similarly in taking the other readings.

(7) At the beginning and end of the season, and at least twice each month during the progress of the leveling, the 1½ ft. interval between the metallic plugs on the face of each level rod must be measured carefully in feet to the nearest thousandth. The same tape should always be used and the temperature conditions be as nearly the same as possible.

(8) The adjustment of the level tube should be tested each day before commencing, and oftener if the instrument is subject to unusual jarring. The test is made by the "peg method," as follows:

At some convenient set-up, after the usual back and foresight readings have been recorded, copy the foresight on a separate line as a new foresight, leave the foresight pin in place and set a second turning pin about 30 ft. back of the instrument; read rod on it for a new backsight; find from these distant and near rod readings, the mean readings in feet as usual. Move the level forward to a set-up about 30 ft. back of foresight pin, take readings on foresight and then on backsight pin. The constant, "C," which is a factor of the adjustment correction, must be determined thus:

$$C = \frac{\text{Sum of near readings in feet—Sum of distant readings in feet.}}{3\ (\text{Sum of greater rod intervals in yards—Sum of lesser rod intervals in yards.})}$$

When the sum of the near reading is greater, the sign of C will be + and vice versa. If the resulting value of C numerically exceeds 0.005 and adjustment shall be made by changing the position of the level bubble only.

(9) Temporary benchmarks shall be established at distances ranging from ¾ to 1¼ miles.

Atmospheric conditions throughout the desert country traversed by the aqueduct form a serious difficulty in the way of carrying on accurate leveling work. Severe winds are of common occurrence, often lasting several days and even weeks, without intermission. Furthermore, the air is very dry at all times of the year and during the five summer months temperatures are high. Several methods were tried to prevent vibration of the instrument and bubble caused by wind, among them the use of a canvas shield (Fig. 3). The most satisfactory method was to set up very low, if possible in sandy or loose soil so that the legs could be sunk deep, and tighten the wing nuts, fastening the legs to the tripod head, more than ordinarily necessary. The rigidity and weight of the tripod and instrument were sufficient under these conditions to withstand any wind that the observer could stand against. The rods were steadied by means of two props, one at the side and one at the back and the bottom held in place by the socket in the top of the pin. There were days, however, in which work had to be abandoned altogether. Heat vibration caused considerable annoyance in flat country and necessitated the shortening of sights to 150 ft., during the noon hour. In hot weather shots averaging 250 ft. in length could be taken until 10.00 a. m. and after 3.00 p. m. These portions of the day were taken advantage of when possible, but no consistent attempt was made to limit work to them, other than to lengthen the noon rest to an hour and a half. When it was possible to keep the line of sight at a considerable distance above the ground surface, the effect of heat vibration was eliminated. By taking advantage of rough topography it was found possible to take shots of 500 or 600 ft., and obtain surprisingly good closures. (See Table herewith.)

TABLE I.—CIRCUIT CLOSURES.

| Circuit. | Length of circuit miles. | Closure error feet. | Value of "C" in eq. $e = C\sqrt{d}$. | Remarks. |
|---|---|---|---|---|
| Pacoima—Majove | 181. | 0.021 | 0.002 | U. S. G. S. precise line along S. P. Ry. [illegible] miles. |
| Little Lake—Five Mile Canon | 9.5 | 0.095 | 0.031 | Very steep, rugged topography. |
| Five Mile—Grapevine Canon. | 25.0 | 0.096 | 0.019 | Mountainous. |
| Red Rock Summit—Fram Siding | 62.5 | 0.090 | 0.011 | Bad land and mountainous topography. |
| Sand Hills | 10.0 | 0.010 | 0.003 | Bad land topography. |
| Deadman—San Francisquito. | 13. | 0.014 | 0.004 | Bad land topography. |
| Newhall | 13. | 0.005 | 0.001 | Rough topography, brushy. |
| Fernando | 5. | 0.005 | 0.002 | Rough topography, brushy. |

Early in the season's work it was discovered that when the sun was allowed to shine directly on the instrument, the adjustment was seriously affected and the constant, "C," varied through a wide range in short periods of time, due to unequal temperature changes. The use of an umbrella controlled this, however.

A serious difficulty arising from the dryness of the atmosphere was that of rod shrinkage. The rods were received new from the maker in February. The weather remained comparatively cool until June and no changes were noticed in the distances between plugs. Hot weather caused a shrinkage which by July 30 measured 0.002 ft. in 10.5 ft. for each rod. The length then remained constant until the end of the work. The shrinkage was measured with a steel tape and checked by rerunning work done prior to its occurrence.

The accuracy of the fieldwork may be judged from the table of circuit closures. The column "length of circuit" is the complete length of the loop and in computing the value of "C" in the equation $e = C\sqrt{d}$, the value of $d$, the distance between benches, was in all cases half the length of the circuit. The requirement prescribed for the main control line that forward and backward runnings differ by less than $0.017\sqrt{d}$ necessitated the rerunning of 10% of the work a third time. The main control line was 247 miles in length. Benches were spaced about a mile apart. The discrepancy in 55% of the mile courses where two runnings were made was 0.010-ft. or less and in 23% was 0.005-ft. or less.

The general opinion among hydraulic engineers seems to be that variations of from 5 to 10% may be expected to occur between the computed and actual flow of water in conduits and canals. It is of interest therefore to know to what extent errors in leveling will affect the actual flow. Assume the method employed in differential leveling as above outlined for the main control line, where the true difference of elevation of two benches is the mean of two runnings. The maximum probable numerical error of such [illegible] an would be ⅓ of the value of $e$ in the equa[illegible] $e = x\sqrt{d}$, assuming the worst probable con[illegible], namely that one running was correct and [illegible] other differed from it by the value of $e$. [illegible] generally accepted Chezy formula for comput[illegible] mean velocity in open channels is $v = c\sqrt{rs}$, where $s = \frac{h}{d}$. Call $h$ the true difference of el[illegible]tion, and $h^1$ an erroneous difference of elevati[illegible] differing from $h$ by ⅓ $e$ or less. Correspondi[illegible] values of $v$ and $v^1$ when compared give the follo[illegible]ing equation:

$$v/v^1 = \frac{c\sqrt{rs}}{c\sqrt{rs^1}} = \frac{\sqrt{s}}{\sqrt{s^1}} = \sqrt{h/h^1}$$

For $x = .017$ in the equation $e = x\sqrt{d}$ there results $e = .017$ for a mile course.

For a grade of $s = .0003$.

$h = .0003 \times 5280 = 1.584$ ft.

$$\text{And } h^1 = 1.584 \pm \frac{.017}{3} = 1.578 \text{ ft. or } 1.590 \text{ ft.}$$

Therefore

$$v/v = \sqrt{\frac{1.584}{1.578}} = 1.0018$$

Thus a variation in velocity 0.2% is possible, due to inaccuracies in leveling within the limit $e = .017\ d$ for a hydraulic grade of $s = .0003$. This variation would, of course, be less for steeper grades.

The speed attained in running levels along the main control line was fairly uniform. The average length of completed levels per month was 64 miles. The average total number of miles of levels run per working day was 5.2. On several occasions, when camp was favorably situated with respect to the work, and the country was fairly level, nine miles were run during eight hours of work. The average time required per mile in open fairly level country was one hour (4 to 5 minutes per set up), although several mile courses were run in 45 minutes. In climbing steep mountain slopes (see Fig. 4) with little horizontal distance to gain, the average speed was from 250 ft. to 275 ft. vertical per hour, or at the rate of 2¼ minutes per set up.

The cost of the work, including payroll, supplies, rental of stock and forage, was as follows:

| | |
|---|---|
| Main Control Line: | |
| Cost per mile of completed levels | $13.20 |
| Cost per mile of all levels run | 8.70 |
| Setting benchmarks from main control line: | |
| Cost per bench | 24.00 |

The total cost of running the main control and setting permanent benchmarks was $5,900. Based on a total length of 235 miles the cost per mile of aqueduct was $25.

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AN IMPROVED FORM OF BLOW PIPE has been invented by A. K. Schaap, 344 Cumberland St., Brooklyn, N. Y., which makes possible the autogenous welding of cast iron, aluminum and other metals with the use of illuminating gas and a blast of atmospheric air. To the ordinary form of blow pipe using air at a pressure of about 1½ lbs. is added a small tube which admits an additional stream of air at a pressure of from 30 to 50 lbs. at a point a few inches back of the flame. The temperature of the flame thus produced has been estimated at 4,500° F. and is such that it will bring the edge of an iron casting to a molten condition in less than two minutes. The high pressure air is admitted through a special valve and in some way not yet satisfactorily explained, seems to effect a more intimate combination of the oxygen and hydrogen than is otherwise possible. This burner, which is patented, is being successfully employed for welding operations in the Schaap Automobile Co.

## A COMBINED GANTRY CRANE AND COAL ELEVATOR.

The unloading of coal, from cars and boats, into the coal bunkers of the power station of the Toledo Railway & Light Co., at Toledo, Ohio, involved difficulties which were overcome by the special gantry crane shown in the accompanying figure.

The main-line tracks adjoin the power-house and between these tracks and the dock front of the Maumee River are two sidings onto which coal cars are delivered. Cars are placed on these tracks only once each day and no shifting is possible at other times. It was not considered practical to build hoppers under the tracks as the cars could be shifted over the hoppers but once each day. Moreover the level of the Maumee River was but slightly below the top of the pier and water-tight hoppers were considered too expensive.

An overhead system of handling the coal thus became imperative and the design finally developed into a gantry crane, spanning the two main tracks and one siding as seen in the cut. Over the dock leg of the gantry is mounted a revolving crane, with a 40-ft. boom carrying a

GANTRY CRANE CARRYING COAL ELEVATOR.
Designed for the Toledo Railway & Light Co. by the Interstate Engineering Co., of Cleveland, Ohio.

scraper type of clamshell bucket. This long boom enables the crane operator to unload four cars without swinging the boom to the other side of the gantry. The coal can be taken, also, from barges alongside the dock. The coal is dumped into a hopper, near the other end of the cross girders, is mechanically fed to the elevator, and is discharged, through hatches in the boiler-house roof, directly into the bunkers.

As the coal cars can be shifted but once each day, it is often necessary to discharge the coal into bunkers at a point which the gantry cannot reach while taking coal from the cars. On this account the hopper at the elevator on the crane is made of 20-ton capacity and the handling capacity of the elevator, twice that of the revolving crane. When the hopper is filled the crane is run along its own track to a point from which the coal can be properly discharged by the elevator. The crane is designed to handle 80 to 90 tons per hour although the normal requirement is only some 60 tons.

The whole crane is operated by two motors. One of these, a 70-HP. series, direct-current, open type, is placed on the revolving crane and does all the hoisting, sluing and propelling of the gantry. The other motor drives the elevator and is placed in a small housing near the top of the elevator. The starting box for the elevator motor is placed in the cab of the revolving crane where the operator has full control of both motors.

The plant was designed and built by the Interstate Engineering Co., of Cleveland, Ohio, at a cost of about $25,000. The cost of handling coal is stated to be about 2½ cts. per ton, including fixed and investment charges.

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THE DERAILMENT OF A PASSENGER TRAIN on the Erie R. R., eight miles west of Meadville, Pa., Sept. 13, resulted in the destruction of two coaches and over 100 ft. of track. The wreck was caused by an open switch, which is believed to have been thrown by persons having a grudge against the company. The train was running 50 mi. per hr. and upon striking the switch was entirely derailed, tearing up both tracks for a distance of over 100 ft. The locomotive was overturned and the first two cars, a combination smoker and baggage and an empty horse-car were demolished. Several passengers in the combination car were injured.

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A REAR-END COLLISION ON THE ELEVATED railway in Brooklyn, N. Y., Sept. 11, caused the death of a motorman and destroyed two of the cars. A three-car Cypress Hills train crashed into the rear of a string of six empty cars on the straight stretch of upgrade track between the Vanderbilt Ave. and Navy st. stations on Myrtle Ave. The train of empties had been stopped so that a member of the crew could extinguish a small fire burning on the ties, and a guard was sent back with a danger flag. In spite of this signalman and the fact that the stationary train was itself plainly visible, the motorman of the Cypress Hills train apparently made no effort to avoid the collision.

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THE "JACKSON SPECIAL" on the Yazoo & Mississippi Valley R. R. was derailed two miles south of Clarksdale, Miss., Sept. 14. A chair car and one day coach were overturned and crushed, killing four women. The train was late and was running at a high rate of speed.

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SMOKE FROM THE NORTHERN FOREST FIRES is said to have been the cause of the wreck of a passenger train on the Lake Shore & Michigan Southern Ry. Sept. 14 at Chesterton, Ind. A combination of fog and smoke from the forest fires obscured the light of the automatic block signal. One woman was killed and 28 persons injured.

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ORVILLE WRIGHT has been making record flights, at Fort Myer, Va., during the past week, with the aeroplane built for the Signal Corps of the United States Army. On Sept. 9 he sailed about over the parade ground for 57 min., 31 sec., for 62 min., 15 sec., and also for 6 min. with one passenger. On Sept. 10 he circled the grounds 58 times in 65 min., 52 sec., and on Sept. 11 he was aloft 70 min., 26 sec. On Sept. 12 Mr. Wright flew his machine 74 min., 24 sec., alone and 9 min., 6⅘ sec., with one passenger. In the first flight on the last date he rose to a height of about 250 ft. On this date a short speed trial over 5.88 miles was also made at an average speed of 38.75 mi. per hr.

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THE EXPLOSION OF THE GAS TANK under a baggage car in the union station at New Haven, Conn., Sept. 10, caused a fire that destroyed the train shed at the west end of the station and badly damaged the Adams Express Co.'s shed. The baggage car had just been backed up at the end of the station to be supplied with gas when the explosion occurred. Two men were in the car and were painfully burned.

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THE FOREST FIRES in Minnesota have continued their work of destruction during the past week. Beaver Bay, Minn., within 50 miles of Duluth, has been burned, and its inhabitants have been obliged to take refuge on the shore of Lake Superior. From the somewhat conflicting reports of Sept. 11, it may be assumed that Grand Marais has been either partially or wholly destroyed after a desperate struggle with the flames. The fire has spread into Ontario and the towns of Port Arthur and Fort Williams are reported surrounded by burning forest. In Michigan, the conditions are improving. Reports of the 14th state that the forest fires in this state are well under control. While even an approximate estimate of the loss inflicted in Minnesota, Michigan and Wisconsin cannot as yet be made, Forest Service officials say that the value of the timber burned will amount to many millions of dollars.

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THE FREIGHT-CAR SITUATION continues to improve, according to the American Railway Association's figures for Sept. 2. The Committee on Car Efficiency reports for that date a total surplusage of 222,632 cars (160 roads reporting), of which box cars make up about 85,000 and coal, gondola and hopper cars about the same number. The decrease since Aug. 19 was 30,371, two-thirds of which is accounted for by decrease in the box-car surplus. This latter is considered an especially favorable sign, as it shows an increase in general merchandise traffic. The total surplus is now only little over half the maximum, 413,605, which occurred April 29, 1908.

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THE HARBOR OF PHILADELPHIA has just been made the subject of a report by Director of Docks Grady and his assistant, Mr. J. F. Hasskarl, M. Am. Soc. C. E., both of whom have spent a large part of the summer investigating the various ports of Europe. The reports of the two officials contain different recommendations so that they are issued separately. Director Grady has been particularly impressed with the enclosed-basin system so common in European ports, and the main feature of his report is the recommendation that, after at least two modern piers have been built in the upper part of the Delaware in the present business section of the city, the marsh land some distance down the river be purchased, before its occupation for business purposes makes its price prohibitive, and on this land be built a series of enclosed basins carrying warehouses. Assistant Director Hasskarl notes that the conditions at Philadelphia do not warrant basins and recommends in addition to modern piers, to replace present delapidated structures, that the marsh lands be filled in to an elevation of 12 ft. and from the bulkhead line piers be built as needed. Both officials recommend power cranes or derricks on the new piers and call attention to the loss in prestige of the port due to the careless maintenance of its present structures. Mr. Hasskarl, impressed by the successful municipal operation of foreign ports, suggests that the city should control more of the river front than at present. Of the distance of nearly 9 miles now under commercial development, the city owns or controls only 8%, the railways 51%, and various other private interests the remainder; of the city's 8% a large part is in the separated street ends which cannot be put to any useful service.

Last year the State of Pennsylvania appropriated $250,000 to be used in improving the river front at Philadelphia, provided the city furnished an equal amount. Director Grady now recommends that the city appropriate this sum, the $500,000 to be immediately applied to the construction of new piers and bulkheads. It is reported that the city administration is favorably inclined toward an appropriation of $1,500,000 for this work, but as yet it has not been made. The federal government is now expending $900,000 in the improvement of the Delaware.

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A PECULIAR FORM OF CONCRETE BUILDING CONSTRUCTION is now being carried out on a building at Camp Perry, Ohio, the practice ground for the Ohio national guard. In this new system the walls are all built flat-side down on the ground, then hoisted into place and joined at the corners, the interior columns, girders and

slabs being afterward placed as separately molded members. The building now under construction, the largest that has been so far attempted, is two stories high and several hundred feet on a side in plan. The side walls were cast in total height, about 50-ft. widths and 4-in. thicknesses. The casting was done on a horizontal platform resting on special steel girders. The window frames, cornices and pilasters were of separately molded blocks placed on the platform and joined to the reinforcement of the 4-in. wall—crossed ¼-in. rods, 6 ins. c. to c. As soon as the wall had set, the entire platform was raised, by means of special jacks acting against the steel supporting girders, to a vertical position and held there by props until the adjoining wall was similarly placed. Then the two walls were connected, by the projecting reinforcement, and the intervening space filled with concrete, laid against vertical forms. Meanwhile, the interior members had been cast and were placed in position, joined together by projecting reinforcement, and all openings filled with concrete. This system is the invention of Mr. R. H. Aikon, Winthrop Harbor, Ill. It has been previously used in several minor constructions.

THE RECLAMATION OF 10,000 ACRES OF FARMland has been accomplished in southern Michigan by the building of earth dikes to hold back the occasional floods. The farm, now under centralized management mainly for sugar-beet production, is located in Saginaw County between the Flint and Bad rivers. Up till 1903 the entire country thereabouts was partly under water at certain seasons and at all times of a marshy nature, but the efficient dike and canal system now installed has turned it into one of the most fruitful large farms in the middle west.

THE WHITE STAR LINER "LAURENTIC," launched last week at Belfast, Ireland, is to be used in the Canadian-European trade, and will be the largest vessel running over that route. She is equipped with both reciprocating and turbine engines, is 565 ft. long, 67 ft. 4 ins. beam, of 14,500 tons gross register, and has accommodations for 1,230 passengers.

A DAM AT WILLIAMETTE FALLS, Oregon, by which the entire flow of the Willamette River is diverted for power purposes during low water, has recently been completed. The power plants which are to be served by this construction were described in an article by Mr. W. P. Hardesty, entitled "The Water and Electric Power Systems of the Portland Ry. Light and Power Co.," in our issue of June 27, 1907, p. 699. Mr. Hardesty now writes, in further description of the dam, as follows:

> The new dam encircles the eastern half of the horseshoe shaped falls, and is over ¼-mile in length. It joins with the dam already built around the west half of the falls. It is of concrete, and varies from 5 to 22 ft. in height, the latter being caused by canyons or breaks in the rim of the falls.
>
> The work was extended from an electric tram railway laid on top of the older dam, by which the materials were hauled from the west side. The new work contains 7,500 tons of concrete, and it was put in in 39 working days. In the top of the dam are pockets, provided for inserting posts for support of flash boards, to more completely divert the water during moderate stages. During the low stages, in late summer and early fall, all of the water can be diverted without flash boards, leaving the crest of the falls completely dry. The work has been carried out under charge of Mr. T. W. Sullivan, hydraulic engineer of the company, and the cost of the new dam is about $100,000.

IMPORTANT CHANGES IN THE WATER FILTRAtion plant of Louisville, Ky., have been recommended by Hering & Fuller, Consulting Engineers, of New York City, in a report to the "President and Board of Water-Works, Louisville Water Co.," which latter is the cumbrous title under which the Louisville water-works are operated. Many of our readers will remember that an elaborate series of experiments on water purification was made in 1895-7 for the Louisville Water Co., under the direction of Mr. George W. Fuller, M. Am. Soc. C. E. Following the experiments the late Mr. Charles Hermany, for many years Chief Engineer of the Louisville Water Co., designed and built a mechanical filtration plant, which plant was put in operation some time ago, but whose operation has been attended with difficulties. The filters, the report by Hering & Fuller states,

> are able to deliver water of satisfactory quality, but when the sand layers become clogged, due to the accumulation of mud removed from the water, it is impracticable to clean them effectively. [Owing to uneven distribution of the wash water].

To obviate this, and to bring the filters into accordance with advances since they were designed, which was some years ago, it is recommended that each of the three filter units should be divided into two, of 6,000,000 gals. capacity each every 24 hours, that the machine for stirring the filter sand during the cleaning be abandoned and that the strainer system be remodeled in general accordance with that designed for the Cincinnati filter plant, which latter makes use of water delivered beneath the bed at such a velocity as to give a vertical rise of 20 to 24 ins. per min.; and that better facilities be provided for removing the wash water. It is also recommended that a coagulating basin be built, as was designed originally, and that this basin have a capacity of 12,000,000 gals.; also, that in place of supplying the wash water under pressure from the elevated water-tank and distribution system, a special tank be provided. The recommended changes, it is estimated, would cost $150,000.

SPECIAL SANITARY INSPECTIONS OF WATERworks drainage areas have been carried out in the State of New York during the past summer. The inspections were made by local authorities at the instance of the State Department of Health, which latter, under a recent amendment of the Public Health Law, notified over 50 water boards and water companies to make immediate inspection of their drainage areas and report to the Department such violations of the rules against water pollution as they might find. In the bulletin of the Department for August, 1908, it is stated that a majority of the 50 local authorities have filed their reports, and that the reports show "that on the whole the public water supplies are well protected from contamination."

## PERSONALS.

Mr. E. W. Kolb has been appointed Engineer of Electric Signals for the Chicago, Rock Island & Pacific Ry.

Mr. Silas W. De Wolf has been appointed General Superintendent of the Texas-Mexican Ry. to succeed Mr. Fount Rice, Jr.

Mr. John H. O'Brien, Master Car Builder of the Mexican Central, who has been in the service of that road for 25 years, has resigned.

Mr. C. C. Smythe has been appointed Acting General Foreman of the Bridge & Building Department of the Chicago, Cincinnati & Louisville R. R., succeeding Mr. S. H. Shinn, resigned.

Mr. J. Walter Ackerman, M. Am. Soc. C. E., Resident Engineer of the Ithaca Street Ry., has resigned that position to become Superintendent of the municipal waterworks system of Auburn, N. Y.

Mr. G. J. Ray, formerly a division engineer of the Delaware, Lackawanna & Western R. R., has entered the service of Timothy Burke, Railroad Contractor who has the contract for section No. 1 of the Lackawanna cut-off in New Jersey.

### Obituary.

James McDougall, Engineer of the County of York, Ontario, for the last 15 years, died Sept. 2 at his home in Toronto at the age of 55 years.

B. F. Ellison, General Manager of the Water, Light & Power Co., of Superior, Wis., died in St. Paul, Minn., Sept. 1. Mr. Ellison was about 55 years old and had been General Manager of the above-named company for the past nine years.

Cabell Whitehead, M. Am. Inst. M. E., at one time Assayer of the U. S. Mint in Washington, died of pneumonia at Nome, Alaska, Sept. 7. Dr. Whitehead was born at Lynchburg, Va., in 1863 and graduated at Lehigh University in 1885. He organized in 1900 the Alaska Banking & Safe Deposit Co., of which he was President.

Thomas M. Richards, First Vice-President of the Philadelphia & Reading Coal & Iron Co., died Sept. 5 at his home in Philadelphia at the age of 73 years. Mr. Richards entered the employ of the Philadelphia & Reading Ry. in 1858 as a clerk, and became General Coal Agent of the coal and iron company at the time of its organization in 1875. He had been First Vice-President since 1906.

Charles K. Lord, President of the Tonopah & Goldfield R. R., died at the Presbyterian Hospital in Philadelphia, Sept. 10, from Bright's disease. Mr. Lord was born in Hoosick Falls, N. Y., in 1848. From 1891-6 he was Third Vice-President of the Baltimore & Ohio R. R. He was one of the four commissioners who supervised the rebuilding of the burned district after the great fire in Baltimore in 1903.

Lewis Williams, Manager of the Cleveland Car Service Association, died Aug. 29 in Los Angeles, Cal. Mr. Williams was born in 1837 at Brimfield, Mass., and graduated at Yale in 1856. He was General Manager of the Cincinnati, Hamilton & Dayton Ry. in 1881 and was the first General Manager of the New York, Chicago & St. Louis R. R., having retired from this position on account of ill health in 1893.

Harry D. Everett, of the Philippine Forestry Bureau, was murdered by the wild hill people of Negros on or about May 4. Mr. Everett was engaged at the time of his death in making a reconnoissance in the interests of his bureau, accompanied by T. R. Wakely, a teacher of the Bureau of Education, who was also killed. The bodies of the two men have been recovered and taken to Manila. Mr. Everett was born in Malone, N. Y.

P. Harry Irwin, Consulting Engineer of the Baltimore & Ohio R. R. Co., died suddenly at Irwin-on-the-James, the ancestral estate in Virginia, Sept. 12. Mr. Irwin was born in Chester, Pa. He was first employed in the service of the Western Maryland R. R., of which he became Chief Engineer and, later, President; about this time he was elected Mayor of Westminster, Md. About 25 years ago he entered the engineering corps of the Baltimore & Ohio R. R. and rose step by step to the position he occupied at the time of his death.

Alfred Stone, an architect of Providence, R. I., died Sept. 4 at Peterboro, N. H. Mr. Stone was born in East Machias, Me., in 1834. He graduated from the high school in Salem, Mass., in 1850 and after that got his architectural education in offices in Boston. He has had an active practice in Providence since 1864. Among the buildings designed by Mr. Stone are the Rhode Island State Prison, the Providence County Court House, and the Providence Public Library. He was Secretary of the American Institute of Architects from 1893-99.

George Barclay Bruce, Consulting Engineer of the Madras (India) Ry., died at his home in London, Eng., Aug. 25, at the age of 87 years. Mr. Bruce was educated by his father, Mr. John Bruce, at whose school in Newcastle-on-Tyne Robert Stephenson received his early education. At the age of fifteen, Mr. Bruce entered the Stephensons' works, and after a six years' apprenticeship was employed by them as an engineer. He was engaged throughout his life in railway construction and was connected with lines in England, India, Germany, Spain and South America. In 1887-8 he was President of the Institution of Civil Engineers.

Gardner D. Hiscox, best known as an author of scientific and technical books, died Sept. 13 at his home in East Orange, N. J. Mr. Hiscox was born in Elizabethtown, N. Y., in 1822. He had no college training. In 1886-90 he acted as Engineer for the Ingersoll Rock Drill Co., which has since been succeeded by the Ingersoll-Sergeant Drill Co., and during the past year he was a contributor to "Compressed Air," the house organ of that company. Among his best known books are "Compressed Air and Its Application," "Modern Steam Engineering" and "Hydraulic Machinery." Mr. Hiscox was a member of the American Astronomical Society.

## ENGINEERING SOCIETIES.

### COMING MEETINGS.

NEW ENGLAND WATER-WORKS ASSOCIATION.
Sept. 23-25. Annual convention at Atlantic City, N. J. Secy., Willard Kent, 715 Tremont Temple, Boston, Mass.

LEAGUE OF AMERICAN MUNICIPALITIES.
Sept. 30-Oct. 2. Annual convention at Omaha, Neb. Secy., John MacVicar, Des Moines, Iowa.

AMERICAN INSTITUTE OF MINING ENGINEERS.
Oct. 1. Annual meeting at Chattanooga, Tenn. Secy., R. W. Raymond, 29 West 39th St., New York City.

ILLUMINATING ENGINEERING SOCIETY.
Oct. 6-7. Annual convention at Philadelphia, Pa. Secy., Van Rensselaer Lansingh, Engineering Societies' Building, 33 West 39th St., New York City.

AMERICAN STREET AND INTERURBAN RAILWAY ASSOCIATION.
Oct. 12-16. Annual convention at Atlantic City, N. J. Secy., B. V. Swenson, 29 West 39th St., New York City.

RAILWAY SIGNAL ASSOCIATION.
Oct. 13-15. Annual meeting at Washington, D. C. Secy., C. C. Rosenberg, 12 North Linden St., Bethlehem, Pa.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.
Oct. 20-22. Annual convention at Washington, D. C. Secy., S. F. Patterson, Boston & Maine Ry., Concord, N. H.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.
Oct. 20-23. Annual meeting at Atlantic City, N. J. Secy., A. P. Folwell, 239 West 39th St., New York City.

AMERICAN GAS INSTITUTE.
Oct. 21-23. Annual meeting at New York City. Asst. Secy., W. Bissell, 29 West 39th St., New York City.

AMERICAN ELECTROCHEMICAL SOCIETY.
Oct. 30-31. Fall meeting at New York City. Secy., Dr. J. W. Richards, Bethlehem, Pa.

ROADMASTERS AND MAINTENANCE-OF-WAY ASSOCIATION OF AMERICA.
Nov. 10-12. Annual meeting at Milwaukee, Wis. Secy., W. E. Emery, West Chicago, Ill.

AMERICAN RAILWAY ASSOCIATION.
Nov. 18. Annual meeting at Chicago, Ill. Secy., W. F. Allen, 24 Park Pl., New York City.

THE EMPIRE STATE GAS & ELECTRIC ASSOCIATION.—The annual meeting will be held in the United Engineering Societies' Building, New York City, Oct. 7. Among the subjects to be discussed are: Electric Meter Testing with Report of the Meter Committee; Affiliation with the American Gas Institute and the National Electric Light Association.

THE MUNICIPAL ENGINEERS OF THE CITY OF NEW YORK.—The first meeting after the summer recess will be held at the Engineering Societies' Building Sept. 23. The paper to be presented, illustrated by lantern slides, is entitled "Bench Leveling and New York City Datums" and was prepared by Mr. Charles Goodman, Assistant Engineer, Board of Water Supply, New York City.

# ENGINEERING LITERATURE

Supplement to ENGINEERING NEWS. 220 Broadway, New York, September 17, 1908.


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Through an oversight we failed to insert the name of the reviewer, Mr. William Kent, M. Am. Soc. M. E., at the head of the review of the University of Wisconsin bulletin entitled "An Investigation of the Hydraulic Ram," which appeared on page 185 of our Engineering Literature Supplement for Aug. 13, 1908.

## CORRESPONDENCE.

### Baldwin on Heating Again.

Sir: There seems to be quite a difference of opinion between Mr. Baldwin and myself on the carrying capacity of steam pipes. (See his letter, p. 183. Aug. 13.) I would like to get it straightened out before revising the figures in my "Pocket-book." Mr. Baldwin says that

"the diameter of a steam pipe always increases directly as the square root of the heating surface, and according to the arbitrary unit here adopted the diameter in inches will be exactly one-tenth of the square root of the heating surface in [square] feet." [Baldwin on Heating, p. 187]. * * * This rule is closely correct for practical conditions and for all sizes of pipe up to about 6-in. diameter [p. 189].

According to this rule the following are the amounts of radiating surface that may be supplied by different sizes of pipe:

| Diam., ins. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Rad. surf., sq. ft..... | 100 | 400 | 900 | 1,600 | 2,500 | 3,600 |

Mr. Wolff's table, page 541 of my "Pocket-book," gives for 2-lb. and 5-lb. pressure respectively:

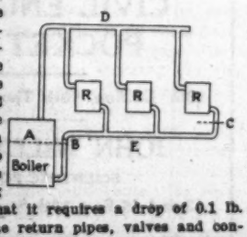
| Diam. in. | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| R. S., 2 lbs..... | 36 | 280 | 900 | 1,920 | 3,720 | 6,000 |
| R. S., 5 lbs..... | 60 | 480 | 1,500 | 3,200 | 6,200 | 10,000 |

Mr. Wolff's figures vary about as the 2.5 power, and in this respect they are in harmony with nearly all the authorities on the flow of steam, gas or air.

It is true that Mr. Baldwin recognizes the existence of this 2.5 power basis, and gives a curve which shows for 4, 5 and 6-in. pipes, respectively, 3,000, 5,500 and 8,700 sq. ft., but he says: "this will be ample for short lengths of straight pipe without elbows, but not for the ordinary ramifications of pipes for a building;" yet in his letter he says: "with short pipes * * * the quantity of steam passed under fixed differences of pressure will vary as the square of the pipe diameters."

Mr. Baldwin further defends the rule based on the square of the diameter by saying that in a gravity apparatus increased length of mains makes necessary a smaller drop in pressure per unit length of pipe, and "for this reason the quantity of the radiation supplied is more nearly in the proportion of the squares, and it is not at all as the 2½ powers." He says further: "It is apparent that any such loss of pressure [as 1/10-lb. in 100 lin. ft. of straight pipe] is prohibitory in practically every gravity apparatus."

Let us come to first principles. D is the steam main whose capacity is to be considered. Let A be the water level when the boiler is steaming. E is the pipe returning the water of condensation from the radiators R to the boiler. Let the radiators be condensing steam at such a rate that it requires a drop of 0.1 lb. to supply it, and let the return pipes, valves and connections be of ample size, so that their friction may be neglected; then the difference of pressure will cause the water level to rise in the return pipe at B, 0.23 ft. or 2.77 ins. Now let twice as many radiators be supplied, the main being doubled in length. The drop will then be four times as much per 100 ft. of length, or eight times as much for the double length (assuming that all the steam is carried the whole length), or 22.16 ins., which may raise the water level in the return pipe to C. But what is the harm, as long as the water does not mount to the radiator? What is there in the theory or practice of gravity apparatus that makes a drop of 0.1 lb. per 100 ft. "prohibitory"?




In regard to using swinging pipes to take care of expansion, I was under the impression that it is preferred by many heating engineers to the use of U's made up of straight pipes and elbows as shown on p. 78 of Mr. Baldwin's book. Some eight or ten years ago the U's were taken out of the large installation in the basement of the Waldorf-Astoria Hotel, New York, and swinging pipes substituted. A year afterwards I was informed that they had stopped all the trouble that had before existed from leaks, broken flanges, etc. It would be interesting to know if they are still in good condition. Wm. Kent.

601 Comstock Ave., Syracuse, N. Y., Aug. 14, 1908.

[We have submitted the foregoing letter to Mr. Baldwin. His reply is appended.—Ed.]

Sir: I have read Prof. Kent's letter in regard to the question of the carrying capacity of steam pipes and the use of swinging joints to care for expansion.

I do not agree with Prof. Kent when he states that there is quite a difference of opinion between himself and myself on the subject of the carrying capacity of steam pipes. We are in agreement at least in so far as principles are concerned, and the disagreement is only in the application of the principles.

I have tried in my book to show the application of the principles to the usual conditions of a gravity heating apparatus, and under such conditions a drop in pressure of 1/10-lb. in 100 lin. ft. of straight pipe is prohibitory in practically every gravity heating apparatus which supplies any considerable amount of heating surface.

Prof. Kent asks why this is so? The reason is that in the ordinary gravity apparatus a drop of 1/10-lb. in pressure per 100 ft. of straight pipe will cause the water to lift into the steam main or into the radiators. If the water merely rises in a vertical return pipe it does no harm. This however, is not the condition which confronts us, but the lifting of water into the steam piping or radiators is what will happen, especially when the apparatus is first started up or when there are variations of pressure in the boiler.

It is, of course, possible, as Prof. Kent suggests, to carry the mains to the attic or upper story of a building and thereby increase somewhat the difference in level between the lowest point of the steam main (which becomes in this case the lowest point of the lowest radiator) and the water line of the boiler. The increased length of the steam mains with this method of piping, however, will usually not allow us to increase the drop in pressure per unit length of pipe. There are, of course, exceptions to this general rule just as there may be exceptionally high basements which might allow of possible reductions in the sizes of steam mains.

In regard to the quantity of steam that pipes will pass, I may say that there are, of course, different conditions to consider. I stated previously that where the loss in pressure due to friction is relatively negligible and the loss in pressure due to influx is relatively large the quantity of steam passed under fixed differences of pressure will vary as the square of the pipe diameters. This, I am sure, Prof. Kent will not contradict, and yet in his last letter he quotes not all but a portion of the above and makes it appear at variance with the rule for the friction losses, namely, that the carrying power of pipes with the same length and the same differences in pressure is as the 2½ power of the diameter. In the first case I specifically state that the friction losses must be negligible. In the second case the friction losses for equal lengths of pipe are the only ones considered. Neither of these conditions meets the requirements of the ordinary gravity heating apparatus.

In the ordinary gravity heating apparatus the length of the steam main does not remain a constant, but increases with the increase of radiating surface. The allowable drop in pressure throughout the apparatus remains, on the other hand, more nearly a constant. Under these conditions, which are the ordinary ones in a gravity heating apparatus, the quantity of radiation supplied (or the carrying powers of the pipes) will vary more nearly in the proportion of the squares of the diameters of the pipes and not at all as their 2½ power. There is one thing in the table which appears in Prof. Kent's "Pocket-book," which I have found confusing to many people, when the table is used for such an apparatus as a gravity heating apparatus. The table gives the amount of radiating surface for various size pipes for a gage pressure of 2 lbs. and a much larger amount of radiating surface for the same size pipes for a gage pressure of 5 lbs.

Many people draw from this the incorrect conclusion that smaller pipes may be used by simply running a gravity heating apparatus at a gage pressure of 5 lbs. instead of 2 lbs. This, of course, is not true; for the pipe sizes depend upon the allowable drop in pressure, which is fixed by the difference in level between the water line of the boiler and the lowest radiator or steam main, and the allowable drop in pressure remains the same whether the plant operates at a pressure of 2 lbs. or of 5 lbs.

It is stated, of course, that the tables are figured for a 2% drop per 100 ft. of straight pipe and an engineer would know that one pipe size gives more drop in pressure than the other.

I have seen quite a number of people, however, who assumed from the way in which the table is stated that a much larger drop in pressure can be allowed in a heating apparatus when the apparatus is operated at a gage pressure of 5 lbs. than when it is operated at a gage pressure of 2 lbs. In an apparatus like a gravity heating apparatus we must allow practically the same drop in pressure and use the same pipe size whether the apparatus operates at a gage pressure of 5 lbs. or at a gage pressure of 2 lbs.

In regard to the use of two swinging joints to take care of expansion I can say that I have seen this method used where there was no twist in the joint as intended, but the spring of the pipes was sufficient to care for expansion.

It may be possible that there are isolated cases where a pipe does twist in the thread and yet does not leak. I, myself, can say, however, that I have never seen such a case, where there was an appreciable pressure on the inside of the pipe. I have, on the other hand, seen so many cases of trouble from this cause that I must consider any such method of allowing for expansion as being very bad practice.

Very truly yours,
Wm. J. Baldwin.

World Building, New York City, Sept. 2, 1908.

## REVIEWS.

### River Hydraulics.

Reviewed by GARDNER S. WILLIAMS,* M. Am. Soc. C. E.

HYDRAULICS OF RIVERS, WEIRS AND SLUICES.—The Derivation of New and More Accurate Formulae, for Discharge through Rivers and Canals Obstructed by Weirs, Sluices, Etc., According to the Principles of Gustav Ritter von Wex. By David A. Molitor, M. Am. Soc. C. E., Designing Engineer, Isthmian Canal Commission. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ x 9¼ ins.; pp. 135; text illustrations and tables. $2, net; English price, 8s. 6d., net.

The work does not purport to be a translation of that of Hofrat von Wex, but rather an application of his theories to certain problems in the light of some data more recent than the original treatise, and a criticism of the various formulae now in use.

The book begins, after a brief introduction, with a discussion of the formulae for the flow through ordinary orifices and notches and brings the reader at once to the question of the influence of the angle between the direction of flow and the guiding walls. The treatment is based upon a derivation of the pressures supposed to act upon the several surfaces encountered by the water at the weir or orifice, and their components in the direction of flow, from the summation of which the total force producing motion is derived, and from this the discharge.

Accepting the fundamental assumption of most common weir formulae that the water in all parts of the channel approaches the weir or orifice with a uniform velocity of approach, the formulae presented in the work are readily seen to be more rational than those now in use, and may well be studied by anyone interested in the laws of flow. The fact, however, remains that the author himself no more than any of the other authorities commonly accepted in the matter of weir and orifice discharge, has taken account of two very important factors in the rational discussion of weir formulae. Neither he nor they make any attempt to recognize the fact that the velocities are not uniform throughout the

*Professor of Civil, Hydraulic and Sanitary Engineering, University of Michigan, Ann Arbor, Mich.

flowing stream, nor do they consider the equally well established fact that the pressure in the stream varies inversely with the velocity. When therefore the author computes the pressure upon the discharge area or the side walls as being that existent under static conditions and adds thereto the influence of the velocity, he at once introduces a false condition which thereafter to a greater or less extent, dependent on the magnitude of the velocity, vitiates the rationality of his remaining conclusions. It may be doubted, therefore, whether the criticisms of existing formulae presented in Appendix A should lead to a discarding of the old formulae for those of the author.

The discussion of the Complete Overfall Weir occupies Chapter II. and includes among irregular forms the Z-shaped weir, but here the fact that the head on the down-stream part will be less than on that above is neglected. In Chapter III. the Incomplete Overfall or Submerged Weir is discussed. Here the author, neglecting the influence of viscosity, follows the lead of Dubuat and divides the overfalling sheet into two sections acting under different forces. To one who has watched the flow of water in large volumes over such weirs this treatment seems anything but rational.

Chapter IV. is devoted to Sluice Gates and Chapter V. to Backwater. The treatment of the latter may be readily applied to a channel of uniform width or of uniformly varying width, and follows that presented in Ruehlmann's "Hydromechanik." But for the case of irregularly varying cross-sections, almost the only practical problem in this connection, the expressions are of little if any value.

Chapter VI. deals with the flows in Rivers and Canals and presents solutions of the cases of branching canals and sudden changes of depth by the aid of Kutter's and of Bazin's formulae. The treatment presented is in advance of anything of the sort with which the writer is familiar, though the results must be accepted with caution and the judgment of the careful experimenter will be needed for their correct interpretation. This chapter closes the theoretical portion of the book. The use of the term "suction" throughout the discussion is rather unfortunate, for the casual reader is apt to think of it as standing for a force rather than for the absence of one.

Chapter VII. is entitled "Empiric Coefficients" and that part devoted to overfall and submerged weirs is unfortunately defective in a lack of recognition of the classic and monumental work of Bazin. The observations of Lesbros and Boileau are used in connection with those of Francis and Fteley and Stearns, and the Cornell experiments, but the very elaborate studies of Bazin are unaccountably omitted. Sluice gates are considered in the light of the experiments of Engerth, Lesbros, Boileau, Weisbach and Bornemann, and for end contractions the formulae of Francis is taken. The subject of irregular crested weirs is treated after the manner of the Hydraulic Tables of Williams and Hazen.

Appendix A, which follows, is a collection of various weir formulae and a criticism of their structure, generally well justified, but, as suggested above, incomplete in lacking a similar criticism of the one propounded by the author.

Appendix B presents a solution of the problem encountered in the Panama Canal of the flow over a flight of locks. It may be inquired whether a similarly accurate result might not have been obtained by a less laborious process, but the treatment is certainly ingenious and very interesting.

The book is one that should be read, and read carefully, by all students of Hydraulics, and from it many clearer notions will be gathered regarding the intricacies of the subject than are likely to be obtained elsewhere. While not viewing the work of Herr Wex as approaching quite so near to perfection as does the author, the writer is far from considering his views "peculiar," and recognizes in his work the painstaking effort of a thorough student to bring together in a scientific manner the knowledge applicable to a great physical problem, and that he failed to anticipate some of the discoveries of the next quarter of a century is certainly a matter to him of no discredit. To the author the profession owes its gratitude for placing within its reach the labors of this all too scantily known authority.

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THE THEORY, DESIGN AND CONSTRUCTION OF INDUCTION COILS.—By H. Armagnat. Translated and Edited by Otis Allen Kenyon, Editor and Translator of Michalke's "Stray Currents from Electric Railways," and Claudel's "Handbook of Mathematics." New York: McGraw Publishing Co. Cloth; 5¼ × 8¼ ins.; pp. 216; 111 illustrations in the text. $2, net.

Recent experiments with induction coils and primary batteries for gas-engine ignition have shown that some coils were far more efficient in doing the work required of them than were others. The claim has been made that the more efficient coils were designed to suit the conditions of their service, as much as present knowledge of their probable action would allow, whereas the less efficient ones were "just built." There has been some excuse for such apparatus as the latter as comparatively few persons have published the results of any illuminating studies of induction-coil apparatus. Until recently there has been in English no book adequately setting forth the extent of our knowledge of this apparatus. For this reason Mr. Kenyon's translation of Armagnat's work is a welcome addition to the literature of the subject. It should be noted in advance that reports of progress since the appearance of the original, in 1904, for the most part are noted only in the translator's additions to the bibliography. It must not be supposed that this book leads to a full knowledge of how to design a coil for a given duty. The author makes this clear again and again when he shows that such apparatus cannot be designed with any of the certainty of an ordinary transformer.

The chapters on elementary theory of action and construction and on historical development form an ample introduction to the deeper studies that follow. Those relating to the coil itself are taken in connection with simple mechanical interruptors in the primary circuit. Here are given numerous complex expressions for values of primary and secondary e. m. f. on closing and opening the primary circuit. The influence of iron cores and of the primary and secondary spark is also discussed. After all this, electrolytic interrupters are theoretically and practically considered. In a chapter on the construction of induction coils, much practice of makers is disclosed, but the theory of actual design is meager. This poverty is indicative of the state of the art and science of such design and of the present necessity of substituting empirical relations, such as between the length, diameter and area of cores, between secondary and primary turns, etc., for the unknown logical expressions.

Much of the book is given up to a discussion of the uses of the coils and to a bibliography of articles on this subject. A brief synopsis of each article listed is given.

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THE SMALL COUNTRY PLACE.—By Samuel T. Maynard, Professor of Botany and Horticulture at the Massachusetts Agricultural College, Botanist and Pomologist to the Massachusetts State Board of Agriculture, Author of .'Landscape Gardening as Applied to Home Decoration," etc. Philadelphia and London: J. B. Lippincott Co. Cloth; 5¼ × 8¼ ins.; pp. 317; 100 illustrations, mostly in the text. $1.50, net.

A wide range of information, some of it in fair detail, is here given for the benefit of those who occupy or contemplate the occupation of small country places and wish to combine profit with pleasure in so doing. There are chapters on remodeling and improving old buildings, on new buildings, on decorating home grounds, on the lawn and flower garden, on the family garden and market gardening, and on different sorts of fruits. Poultry keeping, dairying, the family horse, and bees, are also taken up. The volume closes with directions and suggestions for work which needs attention during each month of the year. The text and illustrations combined promise to prove profitable to a large number of the class of readers for whom the book is intended.

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CURVES FOR CALCULATING BEAMS, ANNELS AND REACTIONS.—A Manual for Engi s, Archi- tects, Designers, Draftsmen, Builders a Contrac- tors. By Sidney Diamant, E. E., Structur Engineer. New York: McGraw Publishing Co. Clo 10 × 7¼ ins.; pp. 13; 25 plates and 6 text illust ons. $2, net.

There are included in this book 13 bles for determining the correct size I-beam a channel under loads varying from 80 to 500 lbs. per sq. ft. and 13 more for the reactions under the same loads. When the designer has become familiar with the use of the tables, as he should in a short time, they should prove very convenient and, since a nicer adjustment between size and spacing may be made, quite economical.

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LECTURES ON THE STATUTORY PROVISIONS RELATING TO GOVERNMENT CONTRACTS.—Delivered before the Engineer School, U. S. Army, Washington Barracks, D. C., by John Mason Brown, LL.B., March, 1908. No. 31, Occasional Papers, Engineer School, U. S. Army. Washington Barracks, D. C.: Pub. Doc. Paper; 6 × 9 ins.; pp. 49.

Mr. Brown, who has been connected with the legal branches of the Controller of the Currency, has had ample opportunity to observe the workings of the law of contracts in government work and is an authority on that sometimes complicated subject. The present pamphlet, while primarily intended for the West Point graduates in attendance upon the Engineer School at Washington, should be of value to any and all contractors doing business with the government. Although limited to the space of three lectures, the material is wisely condensed so that the meat of many decisions is presented together with references to a number of others, the abstracting of which was prevented by lack of time and space.

In our issue of June 13, 1907, p. 669, we reviewed a similar book by Mr. Brown upon the law of contracts, which covered a somewhat broader field than the present booklet. The two make an interesting discussion of government contracts.

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RIPARIAN RIGHTS, NAVIGABLE WATERS IN THE UNITED STATES.—Decisions. Circular No. 13, Office Chief of Engineers, May 17, 1904, with References in Full. Occasional Papers No. 29, Engineer School, U. S. A. Washington Barracks, D. C.: Pub. Doc. Paper; 6 × 9 ins.; pp. 141.

The value of this collection of decisions would have been increased by even a brief introductory note or synopsis, stating the range of the decisions as to time and court jurisdictions. As it is, every decision must be examined separately to learn its character. There is not even a table of contents.

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## New Logarithm Tables.

SAXTON'S LOGS FOR FOUR-PLACE WORK.—Table and Text. Washington, D. C.: E. Saxton (841 Maidensburg Road). Leather; 3¾ × 11 ins.. $3.

In breaking radically with the conventional principles of arranging logarithm tables, the author has succeeded in producing a four-place table of distinct merit. His novel arrangement affords these advantages:

(1) The logs of two-place numbers are in sight without opening the book.

(2) The page on which any given number or log appears can be opened at first trial.

(3) Each logarithm stands directly beside its number, there being but one column of logs per page, in place of ten.

(4) The logarithm of the reciprocal of the number can be taken from a column alongside the log of number, so that subtraction of logs is made unnecessary.

The first two advantages named are secured by cutting the edge of the leaves into a finger index, marked with the numbers 10, 11, 12, * * 99, and the corresponding logs. Each double page contains, in triple column on either page, the hundred subdivisions of the index number, the corresponding logs, and the logs of reciprocals; thus, for the two facing pages which are indexed 19 2788, the book when opened reads:

| Left page. | | | Right page. | | |
|---|---|---|---|---|---|
| N | L | R | N | L | R |
| 19 00 | 278 8 | 721 2 | 19 50 | 290 0 | 710 0 |
| 01 | 279 0 | 0 | 51 | 3 | 709 7 |
| 02 | 2 | 720 8 | 52 | 5 | 5 |
| 03 | 4 | 6 | 53 | 7 | 3 |

In this grouping, rather large type and wide spacing are used, a feature which, of course, means that more space is required than with smaller type or closer spacing. But it is probable that page height was governed by the exigencies of cutting the finger index rather than by spacing of type on the page; for though the index is divided into two columns, it is of none too wide spacing even now.

The sample above will also show how the author divides the figures of the logs. While he claims special merit for this arrangement, its advantages are perhaps no more than sufficient to balance its disadvantages.

The introduction of logs of reciprocals should commend itself to a large majority of those who use logarithms frequently. With ordinary tables, division necessitates either (1) subtracting logarithms or (2) taking the reciprocal (colog) out of the table directly, by making a mental subtraction from 9.9-9-9-10. The latter operation, though to some people it may be as easy as taking out the tabular log, is awkward and uncertain to most men. The logs of reciprocals can therefore save time and trouble, by reducing the entire solution of mixed products and quotients to simple additions of tabulated quantities.

The arrangement adopted for the tables brings with it a minor advantage worth noting, namely, a narrow and therefore unusually convenient book. The greater height as compared with ordinary tables is hardly a disadvantage.

It happens that most of these advantages of the book depend on the use of the cut index; for, without the finger index, the 90 double pages here required for the numbers to 9,999 would be at a serious disadvantage against the nine double pages of the conventional arrangement. The durability of this index, which must be proved by test of time, will therefore determine the permanent utility of the book. In the matter of its present convenience, there is perhaps only one criticism, a fundamental one, however, namely, that the index is more convenient for the right hand than the left. As the right hand must be free for pen or pencil, it would seem that the book should have been built to open at the left, in which case the index would be most naturally situated for the left hand. But the author has already provided innovations enough for a first edition.

It remains to be said that a good list of examples, which follows the tables, illustrates their use and demonstrates the convenience and sufficiency of four-place logarithms. In these examples are given many hints for proper procedure in logarithmic calculation that are badly needed even by some regular users of log tables.


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## High Speed Dynamos.

Reviewed by HENRY H. NORRIS.*

HIGH SPEED DYNAMO ELECTRIC MACHINERY.—By H. M. Hobart, M. Inst., C. E., M. Am. Inst. E. E., M. Inst. E. E., and A. G. Ellis, Assoc. M. Inst E. E., Associate City and Guilds of London Institute. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 6 × 9¼ ins.; pp. 526; 355 illustrations, mostly in the text. $6; English price, 25s. 6d., net.

The purpose of the authors in undertaking the extensive investigation which is the basis of this book has been to study "the influence of rated speed and output on the design of electric machinery." At the outset they call attention to the proposition that, within limits, the greater the number of revolutions per minute the more satisfactory is the design of alternating-current generators, and the less satisfactory is that of direct-current generators. Therefore, for a given rated output the preferable speed will be greater for the former, and less for the latter type.

The book will appeal chiefly to those interested, directly or indirectly, in the design of electric generators. It is apparently not intended to teach the art of designing, but rather to illustrate the use of design data in drawing general conclusions. A wealth of useful information is presented in both tabular and graphical forms. The data are not taken from detached examples, but relate to whole lines of machines selected to illustrate the effects of varying different design factors such as speed, diameter, output, etc. The conclusions of the authors resulting from a study of the numerous examples will be appreciated by users of electric generators even if they are not disposed to follow through the details of the calculations.

The authors have arranged their material in two main divisions, dealing with the two distinct types of turbo-generator. As these two types have fewer features in common than alternators and direct-current generators of lower speed, this division is a natural one. After a few short chapters of a general introductory nature a number of complete designs of several lines of high-speed alternators are worked through. Every detail of dimensions, weights and costs, as affected by frequency, speed and output, is considered. From the results of the calculations, a number of practical and interesting deductions are made. The theoretical matter is followed by descriptions of numerous typical turbo-alternators. These are all of recent construction and thoroughly represent both American and European practice. In discussing the direct-current generator the same general plan is followed, special attention being given to the difficulties imposed by commutation. These descriptive chapters would form by themselves an excellent treatise on recent progress in turbo-generator construction. The remaining chapters might be grouped under the title, "The Theory and Practice of Turbo-Generator Design with Deductions from Numerous Detailed Examples."

An inspection of the reproductions of photographs and drawings in the descriptive chapters indicates that, while differing in many details of construction, turbo-generators are approaching a general standard form. This applies more to alternators than to direct-current machines, although progress is being made with the latter. In the alternator the speed of the rotor (usually the field magnet) is limited only by mechanical considerations, and the limit of output is merely a matter of ventilation. The conspicuous features, therefore, are devices for producing great stiffness and strength, and for rapid circulation of air in and around the heat-producing coils and cores. In the direct-current generator these features are also important, but the construction of the commutator and rotating armature windings is still more difficult, and much ingenuity is now concentrated upon the problem. The illustrations show a number of recent plans for insuring satisfactory commutation. On the mechanical side, steel rings, shrunk on the commutator bars, counteract the effect of centrifugal forces. Electrically, commutation is improved by the use of special commutating poles on the field, and by extraordinary attention to design details. The unusual combination of electrical and mechanical difficulties which are present in the design and construction of the turbo-generator have resulted in the production of a unique type of machine.

In order to illustrate the point of view of the authors in this study a few of their general deductions may be selected. After considering the various factors which determine the most desirable speed for the alternator, they state that "there is a certain speed or a certain range of speed, for a given rated output and frequency, at which the most economical and best design is obtained." They show that for alternators of moderate output four poles should be used, while six or eight are to be preferred in larger machines. Comparing the standard speeds of successful turbines with the speed desirable from the generator standpoint, they conclude that for a frequency as high as 50 cycles per second the slower speed turbines are satisfactory. For alternators of lower frequency and for direct current generators the turbine speed is far too high. In this connection the authors note a tendency toward a reduction in speed in high-speed types and an increase in speed in the lower speed types, but the reasons for this tendency are not given. These conclusions are the most important which are specifically mentioned in the text. In many cases where the lessons taught are not pointed out, the data are arranged in such form that the reader may easily draw his own conclusions.

This book is worth while if for no other reason than that it will impress the reader with the nature and extent of the influence of the steam turbine upon the design and construction of the electric generator. The steam turbine has largely supplanted the reciprocating engine for many purposes. This is principally because, by virtue of its higher speed, the turbine occupies much less floor space. Its field of usefulness is limited, however, by this high speed and by the fact that only in units of fairly large size are its peculiar merits important. For these reasons ship propulsion and electric power generation, particularly the latter, are at present its principal applications. As the alternating-current generator and, to some extent the direct-current generator, may be designed to operate satisfactorily at any reasonable speed and output, they are well adapted to direct connection with the turbine. By means of distributing circuits and standard transforming devices the electric power may be efficiently subdivided and utilized. It is largely through this adaptability of the electric generator to steam turbine operating conditions that the latter has been able to compete successfully with its equally efficient rival, the reciprocating engine.

*Professor of Electrical Engineering, Cornell University, Ithaca, N. Y.

## Gold and Silver.

GOLD AND SILVER.—Comprising an Economic History of Mining in the United States, the Geographical and Geological Occurrence of the Precious Metals, with Their Mineralogical Associations, History and Description of Methods of Mining and Extraction of Values, and a Detailed Discussion of the Production of Gold and Silver in the World and the United States. By Walter R. Crane, Ph. D., Instructor in Mining, School of Mines, Columbia University. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ × 9¼ ins.; pp. 727; 29 illustrations, partly in the text. $5, net; English price, 21s., net.

This, like "Lead and Zinc," which was reviewed in our issue of July 16, 1908, is to form a part of the Economic History of the United States, to be published by the Carnegie Institution of Washington, and was prepared with aid received from that Institution. Its interest and value is mainly of a historical nature, but, since in all cases the records are brought up to this year, it presents considerable information on present distribution, methods of mining and extraction of values. Throughout the book, references are given for those who wish to investigate further any phase of the subject. It incorporates in one volume the results of an extensive research and study of the various sources of information from which its material is drawn.

The discussion of the relation of the mining industry to other industries and to the advance of civilization in general, which appears in Chapter I., assigns to precious metal mining a higher importance than would be readily granted by one whose point of view was not affected by an absorbing interest in that industry.

However, the arguments and statistics which are advanced in support of the views presented are very interesting and, to some extent, convincing.

The following three chapters treat respectively of discovery, occurrence and geological distribution. The records of discoveries are so arranged by states and territories as to make them convenient for reference purposes. Many of the accounts of discoveries of the precious metals or their ores, which include the earliest records and legends, are of interest in themselves apart from their historical value. In Chapter III. is included a brief presentation of the theory of ore deposits and a general discussion of their occurrence which explain these matters in clear and readily comprehensible terms.

Methods of mining and extraction of values are described in detail in the fifth and sixth chapters. After brief historical sketches of the development of these processes full descriptions are given of the various modern methods in use in different regions.

The production of gold and silver from the discovery of North America in 1492 up to the present time is recorded in Chapter VII., in which is included much tabulated data. The effect on production, of the various discoveries of deposits and new methods of mining or extraction of value, is carefully pointed out. A disappointingly meager reference is made to the economic relation between the precious metals, money and industry.

The appendix of tables presents in condensed form much of the information contained in the body of the text. A column of references is included in most of the tables.

Taking into consideration the necessity of employing terms peculiar to the mining industry in much of the descriptive matter, the book as a whole is clearly written and as intelligible, even to the non-technical reader, as could be expected.

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## Compressed Air Plant.

COMPRESSED AIR PLANT FOR MINES.—The Production, Transmission and Use of Compressed Air, with Special Reference to Mine Service. By Robert Peele, Mining Engineer and Professor of Mining in the School of Mines, Columbia University. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5¾ x 9 ins.; pp. 325; 112 illustrations, mostly in the text, and 38 tables. $3; English price, 12s. 6d., net.

The utility of this work is to be judged by the intending readers from a survey of its table of contents rather than from its title. Otherwise the word "mines" may mislead, as four-fifths of the work has no closer relation to mining than to, let us say, railway building. As a matter of fact, about 40% of the whole book is devoted to descriptive discussion of air compressors and their details, whereas no other branch of the author's subject is treated in anything like similar fullness. For example, rock drills are disposed of in ten pages, without a single illustration of rock-drill, bit or mounting; yet, since the author himself says that "by far the most important use of compressed air in mining is for operating machine drills," it might be presumed that drills would be his chief theme.

The author has selected a descriptive style of treatment. In the two subjects which are most fully treated, namely (1) compressors and (2) air engines, chiefly locomotives, this style has ample scope. We find, therefore, an abundance of illustrative drawings—lacking all dimensioning, however—and clear statements of the functioning of the various kinds of valve, etc. Presumably he has covered the field in a representative way, though we fail to find mention of the air-operated valve used in a number of Ingersoll compressor installations. In connection with compressors, their auxiliaries, such as receivers, intercoolers and aftercoolers, pressure regulators, etc., are duly treated, and two chapters on air-compression in high altitudes and compressor explosions cover these essential phases of compressed-air work.

Hydraulic compressors and their inverse, air-lift pumps, are rather well discussed, the former subject closing the first half of the book, Production of Compressed Air.

The second half concerns itself with transmission of air and use of air. The former is represented in a chapter on piping (loss of head, loss of power, and one page on constructional details) and a chapter on freezing. The utilization of air is represented by a chapter on air-engines and one on locomotives, two on pumps (working ordinary steam-pumps by air, and pumping by direct air as in the air-lift and air-displacement pumps), besides the few pages on rock-drills already mentioned; a preliminary chapter treats of reheating, important in surface work but less so in mines.

The book is a useful presentment of its subject in many respects, and offers a safe guide to the practitioner, as far as it goes. It is only occasionally marred by minor defects, such as the meaningless classification of compressors into straight-line, duplex, compound (steam) and multistage; or the reference to the horse-power "developed" by a compressor. It adds to the none too plentiful literature of compressed air practice.

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A TEXT-BOOK OF PHYSICS.—Edited by A. Wilmer Duff. Philadelphia, Pa.: P. Blakiston's Sons & Co. Cloth; 5½ x 8¼ ins.; pp. 680; 511 text illustrations and one plate. $2.75, net.

This work is a collaboration, Professor Duff being the editor of the book and at the same time the author of the section "Mechanics and Properties of Matter." "Heat" was written by Prof. K. E. Guthe, "Wave Motion" and "Sound" by Prof. William Hallock, "Light" by Prof. E. P. Lewis, "Electricity and Magnetism" by Prof. A. W. Goodspeed, "Electromagnetic Induction" by Prof. A. P. Carman, and "Conduction of Electricity through Gases and Radio-Activity" by Prof. R. K. McClung. Prof. Hallock, it seems, was in charge of the work in its early stages, but after planning the general lines of the work he found other duties too exacting, whereupon Prof. Duff carried it through to completion. The purpose of the plan of collaboration is to secure to each section the advantage of being written by a specialist, at the same time preserving unity of treatment. The result is an unexpectedly successful text-book, at once concise, accurate, balanced, and as detailed as the limits of space permit. It promises a wide utility as a learner's text, whether for individual or school use, and almost equal utility as a reference text. Its value in both directions might have been distinctly increased by frequent reference to more exhaustive treatises; indeed, the omission of such references is perhaps the chief criticism to be made of the work.

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INFORMATION FOR ENGINEERS AND DRAFTSMEN. —By F. W. Steeg. Chicago: The Penny Engineer, 167 Dearborn St. Ten cards (Series No. 1); 3 x 5 ins. Price, 10 cts. (12 cts. by mail).

These cards form the first set of a large number, others being in preparation. They are adapted for use with card-index systems, such as are now largely used by engineers and others for filing information. They include tables and diagrams (all especially made and computed) of such matters as are in constant use in the design of structures. This first set includes the strength of timber beams; section moduli; strength and weight of bolts and washers; and the strength of columns composed of single I-beams and wrought-iron pipe.

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INVESTIGATION OF FLOW THROUGH LARGE SUBMERGED ORIFICES AND TUBES.—Part I.: Experiments with Submerged Tubes 4.0 Ft. Square. By Clinton Brown Stewart. Researches in Hydraulics, Daniel W. Mead, Professor of Hydraulic and Sanitary Engineering. Bulletin of the University of Wisconsin, No. 216. Madison, Wis.: The University. Paper; 6 x 9¼ ins.; pp. 84; folding plates and text illustrations. 25 cts.

An abstract of this paper, prepared from advance proofs, appeared in Engineering News of Jan. 9, 1908.


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One could hardly expect to find anything really new in this volume, but anyone who is seeking a lucid and logical presentation of the very elements of the design of direct-current generators will not be disappointed with this text. One could hardly expect, either, that, with any book, an ordinary student could, without factory experience, design generators that would be the equal of those put out by the largest manufacturers of the country. But with the assistance of such a manual as this, one familiar with the elements of electrical engineering should easily pick up the fundamental practice of the design of direct-current generators, to which basis experience and study can only add embellishments and refinements. Many electrical engineers, especially those trained in schools where the influence of men from Columbia University has been strong, will find the arrangement of this book familiar and in some ways similar to their own notes on the courses in design.

The properties of magnetic circuits and the application of "Ohm's law for magnetic circuits" are first given with particular attention to conditions found in commercial machinery. Then follows progressive descriptions of types of direct-current generators and the study of the phenomena back of various actions—such as e. m. f. generation, effects of current in the armature on voltage and field magnetization, sparking and good commutation.

Part II. contains typical calculations for predetermining the voltage and efficiency of a machine, for the proportioning of armature and field resistances, and for determining the dimensions of the magnetic circuits. This part has also a long section on armature windings. Another section gives a little applied mechanics and elementary machine design to fix the size of purely mechanical parts. Space is given here to the experimental determination of the characteristic performance curves of shunt and compound-wound machines.

Part III. takes up the shop construction of generators, mainly by showing some common types of magnet yokes, field poles, pole faces, field windings, armature spiders and punchings, slot shapes, commutator bars and spiders and brush rigging. The reasons for peculiar construction are, of course, exposed.

In this section the author to better illustrate the principles and methods laid down gives the main features in designing a 150-KW., 250-volt, 225 r. p. m. machine from start to finish. This is perhaps the most valuable sing'e feature of the book as here the relation of various tables of experimental data to pure theory is shown. Where certain dimensions and proportions are not obtainable by logical methods the author has inserted tables which are really condensed compendiums of commercial practice on the mooted point. This is the nearest approach to empirical methods of design and corresponds with the practice of the best designers in the country in determining the first dimensions of a new machine.

## Sabin on House Painting.

HOUSE PAINTING, GLAZING, PAPER HANGING AND WHITEWASHING.—A Book for the Householder. By Alvah Horton Sabin, M. S., Author of "Technology of Paint and Varnish." New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Cloth; 5 × 7½ ins.; pp. 121. $1.00; English price, 4s. 6d.

We have taken so much pleasure in reading Professor Sabin's excellent little vademecum that we are disinclined to attempt cataloging its contents even for review purposes. Suffice it to say that the book constitutes a handy road map of the mazy and mysterious realm of paint, whitewash, wall-paper and what not. It is truly, as marked on the title page, a book for the householder, and equally so for the householder's Principal Assistant Engineer. Its influence will minimize the prevalent itch to thin down a can of cheap paint with benzine or kerosene, and may ultimately make it an established practice to buy paint and varnish in a paint-store only.

If the book had told us nothing more than that putty is made of whiting and that white-lead putty sets too hard for use in window-sash it would have been worth the reading; for do we not remember the impenetrable hardness of those numerous putties we have labored with in removing broken panes, an unexplained curse until now we are led to suspect that they probably were white-lead. And, too, that matter of arsenic in wall-paper is now first made clear, and in vigorous terms:

> The talk about people being poisoned by arsenic in wall-paper is nonsense. In the first place, hardly any wall-paper colors contain arsenic; and if present it is there as a precipitate which is insoluble and non-volatile, and couldn't possibly do any harm if there were a hundred times as much. . . . If a room were painted with paris green I do not believe enough arsenic could ever get into the air to be detected by the most exhaustive chemical analysis. The same may be said of the use of white lead; . . . that lead paint on the outside or inside of a house should be a source of danger, or should be other than entirely sanitary, is totally impossible; and, as Sancho Panza said, he that thinketh otherwise hath windmills in his head.

The sections describing the procedure of whitewashing and calcimining, and the detail instructions for paperhanging, are no less practical and interesting than those dealing with paint and varnish. Altogether there are few places at which the reader will not find just what he needs to guide his amateurish hands in the direction of efficiency. One possible point of trouble is Professor Sabin's recommendation to use a round pound brush "with bristles six inches long when new." The intending b... of a brush is likely to hear the paint man f... down this idea, saying that even profess... painters do not use these costly brushes ... more. The buyer will be told that only the ... Russian hogs wear bristles 7 to 7½ ins. ... and even so each hog has only a few such ... long bristles on his neck, so that at last he ... probably decide not to contribute to decima... the world's supply of select hogs and will d... the expensive 6-in. pound brush in favor o... oval or even a flat brush costing but a fo... as much.

THEORY FOR FINDING MOMENT OF RESISTA... OF REINFORCED CONCRETE BEAMS.—By J... Bolton. Birmingham, Ala: The Author (1104 Bro... Marx Building). Sheet, 18 × 12 ins.; diagram.

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No. 338: The Iron Ores of the Iron Springs District, Southern Utah. By C. K. Leith and E. C. Harder. Pp. 102; 21 plates (6 in pocket) and 11 text figures.

No. 340: Contributions to Economic Geology, 1907. Part I.: Metals and Nonmetals, Except Fuels. C. W. Hayes and Waldemar Lindgren, Geologists in Charge. Pp. 482; 6 plates and 26 text figures.

CANADIAN INDUSTRIAL DISPUTES ACT.—UNEMPLOYED IN EUROPEAN COUNTRIES.—Bulletin of the Bureau of Labor, No. 76, May, 1908. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 657 to 1046.

COAL.—By James Tonge. New York: D. Van Nostrand Co. Cloth; 5½ × 8¼ ins.; pp. 275; 10 plates and 46 text illustrations. $2, net.

COMMISSIONERS OF THE TRANSCONTINENTAL RAILWAY.—Report for the Fiscal Year Ending March 31, 1907. (S. N. Parent, Chairman.) Ottawa, Can.: Pub. Doc. (Sessional Paper No 39a). Paper; 6½ × 10 ins.; pp. 29.

DIRECTOR OF FORESTRY OF THE PHILIPPINE ISLANDS.—Annual Report for the Period July 1, 1906, to June 30, 1907. Major George P. Ahern, Director of Forestry. Manila, P. I.: Pub. Doc. Paper; 5¾ × 9¼ ins.; pp. 37; two folding maps.

EIGENGEWICHT, GUENSTIGE GRUNDMASSE UND GESCHICHTLICHE ENTWICKELUNG DES AUSLEGETRAEGERS.—By Kurt Beyer. (Fortschritte der Ingenieurwissenschaften, Second Series, Part 19.) Leipzig, Germany: Wilhelm Engelmann. Paper; 7¼ × 11 ins.; pp. 132; 70 illustrations in the text. 6 marks; American price, $2.40.

THE FINANCES OF GAS AND ELECTRIC LIGHT AND POWER ENTERPRISES.—Effects of a Reduction in the Price of Gas. The London Sliding Scale for Gas. (Supplement to Chapter VI., Page 211.) By Wm. D. Marks, Consulting Engineer. New York: The Author (Park Row Building). Paper; 5 × 7 ins.; pp. 27. 50 cts.

GENERAL INDEX TO PUBLICATIONS OF THE CALIFORNIA STATE MINING BUREAU.—Issued by The State Mining Bureau, Ferry Building, San Francisco, under the Direction of Lewis E. Aubury, State Mineralogist. Bulletin No. 46. Sacramento, Cal.: Pub. Doc. Cloth; 5½ × 9¼ ins.; pp. 54; illustrated.

GEOLOGIC ATLAS OF THE UNITED STATES.—U. S. Geological Survey, George Otis Smith, Director. No. 159; Independence Folio—Kansas. Washington, D. C.: Pub. Doc. Stiff paper; 18½ × 21½ ins.; pp. 7; five plates and two text figures.

GEOLOGICAL SURVEY OF NEW JERSEY.—Annual Report of the State Geologist for the Year 1907. (Henry B. Kümmel, State Geologist.) Trenton, N. J.: Pub. Doc. Boards; 5½ × 9 ins.; pp. 192; 50 plates (1 in pocket).

HOW TO BUILD UP FURNACE EFFICIENCY.—By Jos. W. Hays, Combustion Engineer, Author of "Combustion and Smokeless Furnaces," etc. Chicago, Ill.: The Author (601 Hartford Building). Paper; 3¼ × 6¼ ins.; pp. 47. 50 cts., postpaid.

HYDRAULICS AND ITS APPLICATIONS.—By A. H. Gibson, Assoc. M. Inst. C. E., Senior Demonstrator and Assistant Lecturer in Engineering in the University of Manchester. New York: D. Van Nostrand Co. Cloth; 5¾ × 9 ins.; pp. 757; 310 illustrations in the text. $5, net.

HYDRO-ELECTRIC PRACTICE.—A Practical Manual of the Development of Water Power, Its Conversion to Electric Energy, and Its Distant Transmission. By H. A. E. C. von Schon, M. Am. Soc. C. E., Civil and Hydraulic Engineer. Philadelphia and London: J. B. Lippincott Co. Cloth; 7¼ × 10 ins.; pp. 382; 140 illustrations, mostly in the text, 40 diagrams and 33 tables. $6, net.

INDUSTRIAL ACCIDENTS IN ILLINOIS.—First Report, Bureau of Labor Statistics, for the Six Months Ending Dec. 31, 1907. (David Ross, Secretary.) Springfield, Ill.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 149.

INSTITUTION OF MINING AND METALLURGY.—Transactions, 17th Session, 1907-1908. Vol. XVII. (C. McDermid, Secretary, Salisbury House, E. C., London, England.) London, England: E. & F. N. Spon, Ltd. New York: The Engineering & Mining Journal. Paper; 5½ × 8½ ins.; pp. 547; folding and other plates, and text illustrations.

INTERNAL COMBUSTION ENGINES.—Their Theory, Construction and Operation. By Rolla C. Carpenter, M. M. E., LL. D., and H. Diederichs, M. E., Professors of Experimental Engineering, Sibley College, Cornell University. New York: D. Van Nostrand Co. Cloth; 6 × 9½ ins.; pp. 597; numerous text illustrations and tables. $5, net.

INVESTIGATION OF THE FIRE DEPARTMENT OF NEW YORK.—A Report for the Commissioners of Accounts, by Greely S. Curtis, Consulting Engineer, Representing the Merchants' Association of New York. New York: The Merchants' Association. Paper; 6 × 9¼ ins.; pp. 118.

IOWA ENGINEERING SOCIETY.—Proceedings of the 20th Annual Meeting, Held at Des Moines, Iowa, Jan. 8-9, 1908. Iowa City, Ia.: The Society (Arthur H. Ford, Secretary, Electrical Building). Paper; 6 × 9¼ ins.; pp. 129; folding and other plates, and text illustrations. 50 cts.

JOURNAL OF THE IRON & STEEL INSTITUTE.—Vol. LXXVII., No. II., 1908. Edited by Bennett H. Brough, Secretary. London, England: E. & F. N. Spon, Ltd. New York: Spon & Chamberlain. Cloth; 5½ × 8¾ ins.; pp. 287; 42 plates and 22 text illustrations.

THE KING'S HIGHWAY.—The Nature, Purpose and Development of Roads and Road Systems. By Reginald Ryves, Assoc. M. Inst. C. E., Officer in Charge of the Technical Section of the Chief Engineer's Office, Public Works Department, Madras Presidency. London, England: The St. Bride's Press, Ltd. Cloth; 8½ × 11¼ ins.; pp. 96; 34 illustrations, partly in the text. 5s., net; American price, $2.

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THE MINERAL RESOURCES OF THE PHILIPPINE ISLANDS.—With a Statement of the Production of Commercial Mineral Products during the Year 1907. Issued by Warren D. Smith, Chief of the Division of Geology and Mines, Bureau of Science, Manila. Manila, P. I.: Pub. Doc. Paper; 7¼ × 10½ ins.; pp. 39; eight plates.

NATIONAL ASSOCIATION OF CEMENT USERS.—Proceedings of the Fourth Annual Convention, Held at Buffalo, N. Y., Jan. 20-25, 1908. Vol. IV. Edited by the President (Richard L. Humphrey). Philadelphia, Pa.: The Association (Harrison Building). Paper; 6 × 9 ins.; pp. 418; text illustrations and one folding table.

PHILIPPINE COMMISSION.—Eighth Annual Report to the Secretary of War, 1907. In three parts. (James F. Smith, President Commission.) Washington, D. C.: Pub. Doc. Cloth; 5½ × 9¼ ins.; pp. 669 + 442 + xxix. + 424; folding and other plates, and text illustrations.

THE PRESERVATIVE TREATMENT OF LOBLOLLY PINE CROSS-ARMS.—By W. F. Sherfesee, Chief, Office of Wood Preservation. Circular 151, Forest Service; Gifford Pinchot, Forester. Washington, D. C.: Pub. Doc. Paper; 5¾ × 9 ins.; pp. 29; nine illustrations in the text.

PROFESSIONAL PAPERS, U. S. GEOLOGICAL SURVEY.—George Otis Smith, Director. Washington, D. C.: Pub. Doc. Paper; 9 × 11¼ ins.

No. 62: The Geology and Ore Deposits of the Cœur d'Alene District, Idaho. By Frederick Leslie Ransome and Frank Cathcart Calkins. Pp. 203; 29 plates (2 in pocket) and 23 text figures.

PUBLICATIONS ISSUED BY THE U. S. COAST AND GEODETIC SURVEY, 1816-1902.—Supplement to the List and Catalogue. January, 1903, to August, 1908. By R. M. Brown, Librarian. Washington, D. C.: Pub. Doc. Paper; 7¾ × 11¼ ins.; pp. 44.

RAILROAD AND WAREHOUSE COMMISSION OF THE STATE OF ILLINOIS.—37th Annual Report. Railroads for the Year Ending June 30, 1907; Grain Inspection Department for the Year Ending Oct. 31, 1907; Office Expenses for the Year Ending Nov. 30, 1907. W. H. Boys, Chairman Commission. Springfield, Ill.: Pub. Doc. Flexible leather; 5½ × 8½ ins.: pp. 862; folding and other plates and numerous tables.

RAILWAY TRACK AND TRACK WORK.—By E. E. Russell Tratman, Assoc. M. Am. Soc. C. E., Associate Editor of "Engineering News." Third Edition, fully revised. New York: The Engineering News Publishing Co. London, England: Archibald Constable & Co., Ltd. Cloth; 6 × 9 ins.; pp. 520; 250 illustrations in the text, and 4 large folding tables. $3.50, net.

ROAD PRESERVATION AND DUST PREVENTION.—By William Pierson Judson, M. Am. Soc. C. E., M. Inst. C. E., Author of "City Roads and Pavements." New York: The Engineering News Publishing Co. London, England: Archibald Constable & Co., Ltd. Cloth; 5¾ × 8¾ ins.; pp. 146; text illustrations. $1.50, net.

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SLUDGE ABATEMENT BOARD (Victoria, Australia).—Annual Report for the Year 1907. (E. H. Goodenough, Secretary.) Melbourne, Victoria: Pub. Doc. Paper; 8¼ × 13 ins.; pp. 36; seven plates.

STATISTICAL REGISTER, NEW SOUTH WALES.—For 1906 and Previous Years. Part XIV.—Local Government. Compiled from Official Returns. H. C. L. Anderson, Director, Intelligence Department and Bureau of Statistics. Sydney, New South Wales: Pub. Doc. Paper; 8 × 13 ins.; pp. 859 to 909.

STUDIES OF INCUBATION TESTS.—By H. W. Clark and George O. Adams. (Reprinted from the Journal of The American Chemical Society, XXX., No. 6, June, 1908.) Paper; 6¼ × 9¼ ins.; pp. 1037 to 1041.

TELEPHONE CONSTRUCTION.—Methods and Cost. By Clarence Mayer, Formerly Cost Statistician and Facilities Engineer, Chicago Telephone Co. Appendix A: Cost of Materials and Labor in Constructing Telephone Line. By J. C. Slippy, Consulting Telephone Engineer. Appendix B: Miscellaneous Cost Data on Pole Line and Underground Conduit Construction. (Compiled by the Editors of Engineering Contracting). Chicago and New York: The Myron C. Clark Publishing Co. Cloth; 6 × 9¼ ins.; pp. 284; 103 illustrations in the text and 157 tables. $3, net.

VITAL STATISTICS OF THE COMMONWEALTH (Australia).—For the Quarter Ended 31st December, 1907. Bulletin No. 6, Population and Vital Statistics, Commonwealth Bureau of Census and Statistics. Published under the authority of the Minister of Home Affairs, by G. H. Knibbs, Commonwealth Statistician. Melbourne, Australia; Pub. Doc. Paper; 8 × 13 ins.; pp. 104.

VORLESUNGEN UEBER INGENIEUR-WISSENSCHAFTEN.—By Georg Christoph Mehrtens, Professor of Engineering at the Royal Technical College in Dresden. Part II., Eisenbrückenbau: Vol. I., Gesamtanordnung der Festen Eisenbrücken und Ihre Geschichtliche Entwickelung bis auf die Gegenwart. Leipzig, Germany: Wilhelm Engelmann. Stiff paper; 7¼ × 10¾ ins.; pp. 814; 970 illustrations in the text. 40 marks; American price, $16.


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## RAILWAYS.

ATLANTIC & LAKE SUPERIOR.—One bid only was received by L. A. Audette, Registrar of the Exchequer, Ottawa, on Sept. 9 for the purchase of the Atlantic & Lake Superior Railway, extending from Caplin to a point at or near Paseblac, in the County of Bonaventure, Que., where it joins the Atlantic, Quebec & Western Railway, being a total length of 20 miles of railway, and all its rolling stock, equipment and other accessories thereof, including all franchises. The railway was sold to the Royal Trust Co., Ottawa, at its bid of $350,000. This company also purchased the Baie Des Chaleurs Ry. at the same date for $1,050,000. Noted fully on Aug. 20.

BAIE DES CHALEURS RY.—This line, rolling stock, etc., was sold on Sept. 9. Railway runs from Metapedia to Caplin, Que., a distance of 80 miles, connecting with other lines at each end. See "Atlantic & Lake Superior" above.

BRAZIL.—Bids are asked until Oct. 14 by the Oeste de Minas Ry. Co. for (1) railway material; (2) railway construction; (3) installation of telegraph line. For details see under Foreign Contracts in this issue.

CANADIAN RIVER.—This company has been incorporated in Guthrie, Okla., with a capital of $5,500,000 with the following directors: A. M. Appelget and H. B. Peebles, of Woodward, Okla.; Charles A. Barden, Boston, Mass.; Henri C. Morand, New York, and F. L. Hamilton, Raton, N. Mex. The principal offices of the new concern will be located in Woodward. The railroad will run from Woodward in a southeasterly direction through Woodward, Dewey and Blaine Counties to a point near Watonga, Blaine County. One line will extend through the counties of Blaine, Kingfisher and Logan to Guthrie; and another from the point of divergence through Blaine, Kingfisher, Canadian and Oklahoma Counties to Oklahoma City, a total estimated distance of 220 miles.

CHICAGO, WHEATON & WESTERN.—Incorporated to construct a railway which will tap the region north of Wheaton, Ill., and will connect the Aurora, Elgin & Chicago Railroad with West Chicago. General offices, Chicago. Capital stock, $10,000. Incorporators: J. Sydney Condit, J. Percy Strickland, D. W. Peters, R. B. Tabor and H. C. Wood, all of Chicago.

DELAWARE & EASTERN RAILWAY.—This company has awarded contract for the construction of its line from Schenectady to Grand Gorge, N. Y., which is to form part of its road between Schenectady and Wilkes-Barre, Pa., to the W. J. OLIVER CONSTRUCTION CO., Knoxville, Tenn. O. F. Wagonhorst, Downsville, N. Y., is Ch. Engr. As noted on June 11, "the Delaware & Eastern Construction Co., organized to build railroads, was incorporated with the Secretary of State at Albany, N. Y., on June 2, with a capital of $300,000. The directors are William Sibbert and D. Fleugrepstein, of Brooklyn, and William C. Relyea, 76 William St., New York. The Delaware & Eastern R. R., which is projected as a coal-carrying road, running from Wilkes-Barre, Pa., to Schenectady, N. Y., and rivaling the Delaware & Hudson, is now under construction in its middle section, but the two ends in this state, embraced in the Schenectady & Margaretsville and the Hancock & East Branch Railroads, are defending litigation in the courts."

GALATIA, HARRISBURG & SOUTH EASTERN.—A. J. Webber, Pres., Galatia, Ill., advises us that this company proposes to build a railway from Galatia to Harrisburg, Ill., ten miles. Grading is practically completed, bridges are built and some ties are on the right-of-way, which has been already obtained. Surveys have been run. Capital is partly secured. Noted on Aug. 6.

GALESBURG, ALEDO & NORTHWESTERN.—This company, with principal office in Galesburg, Ill., has been incorporated to build a railway from Galesburg in a north and northwesterly direction, through the Counties of Knox, Warren and Mercer to Aledo, and thence through the County of Rock Island to the city of Rock Island, Ill., and the city of Muscatine, Iowa. The incorporators and first Board of Directors are Lafayette Weinberg, G. B. Churchill, F. W. Latimer, B. F. Arnold, E. R. Drake, Charles L. Hibbard, C. F. Hurburth, Lake W. Sanborn and Thomas W. Petersen. Capital stock, nominally, is $10,000.

GRAND RAPIDS & NORTHWESTERN.—We are officially informed that "the contract for the first 20 miles of grading, bridging, and fencing has been let to JOHN DOYLE, of Grand Rapids, Mich. The line is to be built to a very high standard with permanent structures everywhere. It will occupy the entire west shore of Ludington Harbor for trans-lake and car-ferry traffic and will occupy the Bridge St. Terminal at Grand Rapids in conjunction with the Grand Trunk Railway. Marshall F. Butters, of Ludington, Mich., is Pres. of the railroad company, and all of its construction work will be under the supervision of the NATIONAL CONSTRUCTION CO., Tacoma Bldg., Chicago, of which Walter S. Syrett is Pres. and T. R. Philbin, Ch. Engr." Noted on July 30.

IOWA & OMAHA SHORT LINE.—Incorporated in South Dakota. Preliminary surveys are being made and right-of-way secured. Organized in Iowa with $1,000,000 capital. Company will build from Omaha, Neb., east to Des Moines, Iowa, 140 miles. The projected route is from Omaha east via Council Bluffs, Iowa; Treynor, Carson, Oakland, Walnut, Elkhorn, Exira, Panora and Dallas Center to Des Moines. G. W. Adams is Pres., Walnut; C. L. Kirkwood, Vice-Pres., North Branch; A. L. Ingram, Treas., and P. Kathmann, Secy., both at Treynor.

MARSHALL & EAST TEXAS.—The company's forces are making improvements which will cost over $100,000, according to an official announcement. Noted fully on Sept. 3. A. T. Perkins is Pres., St. Louis, Mo.

MERIDIAN & SOUTHWESTERN.—Company has not been organized or incorporated yet. Preliminary survey has been made from Meridian, Miss., southwest, about 100 miles toward Natchez, Miss., 175 miles, it is reported. A record of the authorization is filed at Jackson, Miss., with the Secretary of State. Among those interested are William A. Wall, of Raleigh, Miss.; William Cornell, of Lake, Miss.; A. H. Longino, of Jackson, Miss., and others. See "Mississippi River & Western" Ry. item in issue of Sept. 10.

MEXICAN CENTRAL.—Contract may soon be let for the construction of a cut-off on the Mexican Central Ry., between Micos and Las Crucitas, on the Tampico-Aguascalientes division. This cut-off will elminate some of the worst curves on the whole system. There is to be much other work done on the several roads comprising the government merger system, in the matter of eliminating curves and reducing existing grades, it is said. Surveys for these proposed improvements are in progress at several places. L. Kingman is Ch. Engr., Mexico City, Mex.

NEW ORLEANS, MOBILE & CHICAGO.—The Mississippi Railroad Commission held a special meeting on Sept. 11 and ratified the action of the stockholders of the Mobile, Jackson & Kansas City, the Gulf & Chicago and the New Orleans, Mobile & Chicago companies, in consolidating and merging the three lines under one name, the New Orleans, Mobile & Chicago. Noted on June 18.

OKLAHOMA, VERNON & MEXICO.—J. M. Ross and J. W. Gillespie, of Enid, Okla., are promoting a company to be known as the Oklahoma, Vernon & Mexico R. R., which will run from some Oklahoma town, probably Enid, through Vernon, Tex., across the Texas plains and enter Roswell, N. Mex.

PENNSYLVANIA R. R.—L. E. STURM, Wyandotte Bldg., Columbus, Ohio, has been awarded contracts aggregating $30,000 for the masonry work in connection with the subways to be built where the Pennsylvania R. R. crosses Sandusky and Darby Sts. and Rogers Ave., Columbus.

ST. LOUIS, BROWNSVILLE & MEXICO.—The company has closed a contract for building a branch line from Buckeye, in Matagorda County, Tex., to the end of the Tres Palacios Rice Co.'s lands, a distance of ten miles. Company has awarded contract to FRAZIER & McDOWELL for building a branch line from Donna, on the Hidalgo branch to the site of the new sugar mill and refinery, a distance of 2¼ miles. The mill is to be erected by Frazier & McDowell.

SAVANNAH, AUGUSTA & NORTHERN.—It is stated that construction will be commenced soon. This railway is to extend from Savannah, Ga., to Chattanooga, Tenn., 380 miles, with branch to Augusta, Ga., 40 miles. Track has been laid from Statesboro, Ga., to Garfield, 25 miles, and 34 miles additional graded. Wm. H. Lynn is Pres., 111 Broadway, New York. E. M. Rice is Ch. Engr., Statesboro, Ga.

SPARKS & WESTERN.—This company will build a railway, 25 miles long, from Sparks to Moultrie, Ga. Capital, $100,000. The incorporators are: John R. Barfield, of Dooly County; R. L. Wilson, of Crisp County; W. J. Rogers, H. C. McDaniel, B. Z. Whitehurst, Jr., M. Studstill, J. S. Sirmans, F. C. Adams, W. J. McKinney, A. J. Whitehurst, S. G. Ethridge, all of Sparks.

TEXAS & NEW ORLEANS.—Contract has been given to the SUDERMAN-DOLSON CO., Galveston, Tex., for building an extension eight miles long, from Gallatin to Rusk, Tex.

WASIOTA & BLACK MOUNTAIN.—It is officially announced that contract has been let to T. J. ASHER & SONS, Wasiota, Ky., for building ten miles of line from Wasiota, Ky., on the Louisville & Nashville, north to coal fields owned by Asher & Sons. The work includes one bridge and one tunnel. T. J. Asher is Pres.; A. B. Gloster, Ch. Engr., Middlesboro, Ky. Noted on Aug. 13.

## ELECTRIC RAILWAYS.

GOUVERNEUR, N. Y.—Anson A. Potter, of Gouverneur, is interested in plan to build an electric railway, to be about 100 miles in length. Engineers will be sent out shortly to go over the route and make maps of the same. Company has not been organized yet. Right-of-way is being secured.

BATAVIA, N. Y.—Bids will be considered by the Genesee & Orleans Elec. Ry. Co. for construction of its proposed line from Batavia to Point Breeze on Lake Ontario, 27 miles. Right-of-way is obtained and surveys made. Capital, $350,000. Franchise calls for a railway of standard construction. Geo. W. Mische, of Geo. W. Mische & Co., Rochester, N. Y., has bought an option on the franchise, consents, etc., and is to finance the construction of the line.

*YORK, PA.—Bids are asked by the York Rys. Co. for grading. See item under Miscellaneous Contracts.

IRWIN, PA.—The Manor Valley Ry. Co. has awarded contract to RYAN & CAMPBELL, of Latrobe, Pa., for building its line between Irwin and Hermine. Estimated cost, $50,000. T. F. Wolf and W. L. Caruthers, Irwin, are Ch. Engrs.

PITTSBURG, PA.—The Carrick & Baldwin St. Ry. Co. has been incorporated to build a street railway between the borough of Carrick, Allegheny County, and a point in Baldwin Township. The line will be about one-third of a mile in length. Directors: F. K. Martin, Pittsburg, Pres.; J. C. Bily, F. K. Martin, J. G. Evans, S. T. Tone and W. B. Carson.

HUNTSVILLE, ALA.—The Huntsville, Chattanooga & Birmingham Interurban Ry., Light & Power Co. has been incorporated, with authorized capital of $50,000, by Ed. L. Pulley and others. The officers and incorporators are Mrs. Jimmie V. Lowry, Pres.; Dr. Wm. J. Pulley, Vice-Pres.; N. O. Wallace, Secy.; Chas. H. Pulley, Treas., and Ed. L. Pulley, Gen. Mgr. Company has a franchise to build from Huntsville to the State Fair Grounds, as noted on Sept. 3.

LOGANSPORT, IND.—The Logansport, Frankfort & Indianapolis Traction Co. has been incorporated with a capital stock of $25,000 to build an electric line from Frankfort, Ind., north to Logansport, 35 miles. The Directors include: S. H. Blakeslee, Allen G. Barane, Eben Miller, Frank Sargent, all of Cleveland, Ohio; Wm. W. Palmer, New York; Ephraim A. Thomas, Pittsburg, Pa., and W. P. Clark, Kent, Ohio.

INDIANAPOLIS, IND.—Harry C. Sandusky, Ch. Engr., of the Indianapolis, Cloverdale & Terre Haute Elec. Ry. Co., 413 State Life Bldg., Indianapolis, advises us that second survey will be made in the latter part of this month and early in October; the route will be changed to run due west from Eminence into Cloverdale. Line will be 90 miles long. Edward Boeman is Pres., Indianapolis. Right-of-way is 90% secured. Capital is now being arranged for. Contracts probably will not be let before Jan. 1. Noted on June 18.

STOUGHTON, MICH.—The Cincinnati Construction Co. has applied to the City Council of Stoughton for a franchise to build a line through this city. As noted last week this "company is now completing the final surveys for its proposed electric railway which is to connect Janesville, Edgerton, Stoughton, Lake Kegonsa, Lake Waubesa and Madison. H. H. Zigler, Columbus, Ohio, is Pres., and Joseph Ellis, Janesville, Wis., Mgr. and Ch. Engr." Noted on Aug. 13.

FLINT, MICH.—The Saginaw & Flint Ry. Co. has been incorporated and has purchased the street railway formerly owned by the Detroit, Flint & Saginaw Ry. Co. The new company will immediately begin work building the line to Flint. Incorporators: A. J. Groesbeck, Mark Mitshkun and N. A. Tabor. Officers: A. J. Groesbeck, Pres.; N. A. Tabor, Treas., and Mark Mitshkun, Secy. Principal office, Detroit, Mich. Purchasing Agent, M. Mitshkun, Isabella and E Sts., Detroit, Mich. Noted on July 23.

MONMOUTH, ILL.—The Rock Island Southern Interurban R. R. Co. will soon begin construction on its extension from Monmouth to Rock Island. The WALSH CONSTRUCTION CO., Davenport, Iowa, has the contract. Estimated cost, $1,500,000. F. H. Lanchshire is Ch. Engr., Davenport, Iowa.

HOLDREDGE, NEB.—The Western Central R. R. Co. has been incorporated to construct an electric railway from Holdredge to a point a few miles west of Kearney. The company is now engaged in making the survey and securing the right-of-way. Capital stock, $250,000. Directors: T. E. Brady, Charles Stanton, J. G. Burlingham, E. O. Carlson and S. C. Nelson, all of Omaha, Neb.

BROOKINGS, S. DAK.—The Brookings & Sioux Falls Interurban Ry. Co. is constructing an interurban railway from Brookings to Sioux Falls, a distance of 65 miles. Of this 16 miles have been graded and bridged and the company will be in the market very soon for rails and ties. The General Electric Co. gasoline-electric motor cars will be used. Isaac A. Smith is Ch. Engr.

BILLINGS, MONT.—Surveys are being made by the Billings & Cooke City Elec. Ry. Co., which was recently incorporated in Montana to build and equip an electric railroad which will extend from Billings to Cooke City, passing through Laurel, Park City, up the Stillwater Valley to the mining camp. Headquarters, Billings. Capital stock, $5,000,000. Among the promoters named are: J. B. Clayberg, Helena; M. E. Estep, Chicago, Ill.; E. M. Hosky, Helena; George E. Savage, Butte; Thomas Harney, Galena, Ill., and A. L. Babcock, B. G. Shorey and Theodore Martin, Billings.

KANSAS CITY, MO.—The Interstate Railway & Power Co. has been organized in Kansas City to build extensive lines of electric railways in Kansas, Missouri and Oklahoma. Among those interested are William G. Holt, Attorney-at-law; George H. Bunting, R. C. Rawlings, W. A. Rule, J. W. Hoffman, W. P. Dewar and others of Kansas City, Mo.

FORT WORTH, TEX.—The Fort Worth & Mineral Wells Electric Interurban Ry. will build a railway 53 miles long. Right-of-way has been given and the line has been surveyed. Frank Pratt is Engr.-in-Charge, at Mineral Wells, Tex.

CORSICANA, TEX.—The Central Texas Traction Co., incorporated under the laws of Delaware, will build an electric railway from Corsicana to Palestine, Tex. Capital stock, $300,000. Incorporators: J. J. Sears, Aledo, Tex.; Dr. J. O. Howard, Houston, Tex.; W. W. Clopton and J. V. Watkins, Corsicana, Tex.

GAINESVILLE, TEX.—We are officially advised that the Gainesville, Whitesboro & Sherman Interurban Elec. Ry. Co. has awarded the general grading contract to O'REILLY, CALLAHAN & GIVEN, of Chicago. The TENNY CONSTRUCTION CO., Silver City, N. Mex., is the sub-contractor. The line is completed twelve miles out from Gainesville. As projected, the railway will connect Gainesville and Sherman and will be 39 miles long. John King is Pres. and L. M. McArthur is Ch. Engr., Gainesville. Surveys are made and right-of-way secured. Capital is partly obtained. Noted on Aug. 6, under Railways.

CHICKASAW, OKLA.—It is expected to begin grading on the Oklahoma City & El Reno Electric Interurban Ry. about Nov. 15. Surveys, right-of-way and franchises are now being secured. It is proposed to build this line from Chickasaw, Okla., southeast to Sulphur. Scott Jones is Pres., Chickasaw. Noted on May 7.

CANON CITY, COLO.—The President, Kansas-Colorado R. R. Co. has applied for a charter to engage in business in Kansas. As previously noted we were officially advised recently that surveys are partly made for the projected railroad from Canon City to Garden City. Contract has been let to A. B. HULIT, Central Block, Pueblo, Colo., for construction of the western division. The total length will be about 350 miles. S. H. Atwater, Pres., Canon City.

POMEROY, WASH.—The Idaho Railway & Navigation Co., of Spokane, Wash., has been incorporated in Washington to build an electric railway from Deadman's Creek in the northern part of Garfield County through Asotin County and around the Blue Mountain range to the Seven Devils mining district in Idaho, a distance of 77 miles. The single-phase system will be installed. The power station will be erected on Snake River and, together with the distributing stations, will cost $64,000. Capital stock, $100,000. Incorporators: D. Van Arsdale, Pres.; Samuel L. Tate, Secy.; C. W. Hadley, Gen. Mgr.; M. Wood, Engr.; Lester P. Edge and Fred Larson, Spokane.

SPOKANE, WASH.—The Spokane, Columbia & Western Ry. Co. has been incorporated in Washington to build a line from Spokane to the mouth of the Spokane River near Miles, 75 miles. The road may be extended northward along the Columbia River on the boundary of Ferry and Stevens Counties, 100 miles. Surveyors are in the field and it is expected part of the line will be constructed this year. The road will be operated by power from the Nine Mile plant, owned by the Spokane & Inland Empire Electric Railway. Capital stock, $3,000,000. Incorporators: Clyde M. Graves, Waldo G. Paine, W. G. Davidson, H. B. Ferris and Will G. Graves.

MEDFORD, ORE.—F. J. Blakeley has applied to the City Council for a franchise to operate a street railway in this city.

HANFORD, CAL.—The Hanford & Fresno Elec. Ry. Co. will be incorporated in California to build an electric railway from Hanford to Laton, Kingsburg, Selma, Fowler, Malaga and Fresno; also from Hanford to Grangeville, Lemoore and Riverdale; also short extensions. Capital stock, $1,000,000. The stockholders include O. F. Woodward, L. A. Nares, of Laton; A. J. Wishon, W. Kerckhoff and A. C. Balch, of Los Angeles; F. S. Granger, of Hanford; and William Clark. Mr. Nares is Pres.

## LIGHT AND POWER PLANTS.

*MERIDEN, CONN.—See item under Buildings.

NEW YORK, N. Y.—Bids are asked by J. W. Stevenson, Comr. of Bridges, until 2 p. m., Sept. 24, for the installation of the electric wiring, lamps, fixtures, etc., for the lighting of the Blackwell's Island Bridge, over East River, between the Boroughs of Manhattan and Queens.

NEW YORK, N. Y.—Bids are asked until 3 p. m., Sept. 24, by the Park Board, Henry Smith, Pres., for all labor and materials required for changes in electric circuit work, fire alarm and watchman's detector system, night lighting system, changes in elevators, etc., for the Metropolitan Museum of Art.

TONAWANDA, N. Y.—The TONAWANDA POWER CO. has the contract for supplying the energy for operating three 500-HP. motor-driven centrifugal pumps which are now being installed by the city of Lockport on the banks of the Niagara River, for the purpose of forcing water through a 36-in. pipe line from the Niagara River to the city of Lockport, a distance of twelve miles. Electricity is received from Niagara Falls at a voltage of 22,000 and transformed to 4,400, at which it is used. F. M. Gordon is Gen. Mgr., North Tonawanda.

*ALBANY, N. Y.—Bids are asked by the State Commission in Lunacy until 3 p. m., Sept. 23, for work at various State Institutions as follows: For conduits for acute hospital, construction, including steamping, at the Binghamton State Hospital at Binghamton, N. Y.; for conduit for acute hospital, constructing, including steamping, for the Hudson River State Hospital at Poughkeepsie, N. Y.; for conduits for Nurses' Home and Farmer's House, construction, including steam piping and electric cables; day room annexes, construction, including heating and electric work; and pavilion for contagious diseases, construction, at the Middletown State Hospital at Middletown, N. Y. and for boilers, heater, tank and piping at the Long Island State Hospital, Flatbush, N. Y. T. E. McGarr is Secretary of Commission; F. B. Ware is State Arch., Albany.

BRUNSWICK, N. J.—The Androscoggin Pulp Co. has recently sold the old pulp mill site in Brunswick to the Brunswick Electric Light & Power Co., which will develop the water power and erect an electric plant. Plans are now being prepared but they have not been submitted to contractors. A crew of men is engaged clearing the site of the old mill. The Brunswick Electric Light & Power Co. has awarded the contract for building the power station at Brunswick to R. D. SHANAHAN. Work will commence at once.

WASHINGTON, D. C.—The Superintendent of the new National Museum Building, Washington, D. C., has awarded contract for the wiring of the south pavilion to COBURN & COOKE, Newport News, Va., at $10,494.

WASHINGTON, D. C.—Bids will be received until Oct. 3 by William A. Smith, Acting Ch. of Bureau of Yards and Docks, Navy Dept., Washington, D. C., for furnishing four 1,000 and two 500-KW. turbo-alternators for the U. S. Navy Yards, New York, Philadelphia, Norfolk, Mare Island and Pugent Sound. Estimated cost of work, $127,500. Specifications are on file at the office of Engineering News, New York.

ST. PETERSBURG, FLA.—The Electric Light & Street Car Co. will build an addition to its plant, install $15,000 worth of machinery and make other improvements. Equipment will include a 400-HP. Corliss engine, 250-KW. light dynamo and 250-HP. boiler.

NASHVILLE, TENN.—The Board of Public Works has awarded following contracts for machinery to be installed in the $200,000 addition to municipal electric-light plant, previously mentioned: Division No. 1, turbine and accessories, ALLIS-CHALMERS CO., Milwaukee Wis. $43,490; Division No. 2, exciters, etc., ALLIS-CHALMERS CO., $6,740; Division No. 3, pumps, one air and three water, the NASHVILE MACHINE CO., of Nashville, $3,673; Division No. 4, steampiping, NASHVILLE MACHINE CO., $2,425; Division No. 5, switchboards and accessories, WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa., $4,865; Division No. 6, steel water tank, NASHVILLE MACHINE CO., $267.

NEWTON FALLS, OHIO.—Roberts & Abbott Co., Engrs., Schofield Bldg., Cleveland, have prepared plans for two power-houses, to be built at Newton Falls, for the Peerless Electric Co., Warren, Ohio, at $60,000.

GALLIPOLIS, OHIO.—We are officially advised that Samuel Hanaford & Son, Hulbert Block, Cincinnati, have let contracts for a power-house for the Ohio Hospital for Epileptics, Gallipolis, as follows: Engine, SKINNER ENGINE CO.; 125-KW. generator, etc., WESTERN ELECTRIC CO., New England Bldg., Cincinnati; switchboard, wiring, etc., EWER HOPKINS CO. Dr. W. H. Prichard is Supt.

LOGANSPORT, IND.—The WESTINGHOUSE ELECTRIC & MFG. CO., of Pittsburg, Pa., has secured the contract for re-equipping the electric light plant at $27,908. The AMERICAN BOILER & SHEET IRON WORKS, of Indianapolis, secured the contract for an 80-ft. stack for $666. C. F. Hammontree is City Clerk.

COFFEYVILLE, KAN.—The Coffeyville Electric Light & Power Co.'s plant will be enlarged soon. A Corliss engine and a 300-KW. generator will be installed. E. L. Rossiter, Coffeyville, is Mgr.

ST. LOUIS, MO.—Isaac S. Taylor, Arch., 715 Locust St., has let general contract to the E. A. STEININGER CONSTRUCTION CO., Victoria Bldg., for a two-story power-house for the Missouri Baptist Sanitarium. Cost, $10,000.

LAFAYETTE, COLO.—The Northern Colorado Power Co. has decided to increase its bond issue from $3,000,000 to $6,000,000 to provide money for proposed extensions to its transmission lines and to increase the capacity of its power plant at Lafayette. William J. Barker, Mercantile Bldg., Denver, Colo., is Pres.

SAN DIEGO, CAL.—The Benson Lumber Co., O. J. Evenson, Local Mgr., will start work about the first of the year on erection of an electric power plant and also a plant for manufacture of carbolic acid, turpentine wood alcohol and other chemicals obtained from wood, entire improvement to cost between $25,000 and $30,000.

PRESCOTT, ARIZ.—At a meeting of the stockholders of the Octave Mining Co., held in the company's offices here recently, the Central Arizona Electric Co. was organized and the interests of the Octave Mining Co. in the proposed power plant at Kenburg transferred to it. Forty thousand shares of the capital stock of $200,000 were subscribed at par and the directors were authorized to issue $60,000 of 8% five-year bonds, payment of which is guaranteed by the Octave Mining Co. The contract for the electric installation is awarded to the HOUSE ELECTRIC & MFG. CO., Pittsburg, Pa. This concern will have all machinery on the ground at Wickenburg within 90 days. The first unit of the plant will be of 650 HP. Its estimated cost is $ 000. It is the intention to enlarge the by the addition of four other units as the demand of power justifies. With the installation of the plant all machinery in the Octave mines will be run by electricity. The indicated horse-power of the Octave plants is estimated at 400. This leaves 2 HP. of the first unit for sale, contracts for which are already signed to be delivered as soon as the plant is installed. The management has announced that power will be furnished the mines of the Wickenburg, Black Rock and Weaver Districts. C. E. Mieso, of Chicago, Ill., is interested. O. A. Knox is Pres. and Gen. Mgr., Octave Mining Co.

PORT ARTHUR, ONT.—The statement published on Sept. 10, that "the plans of Cecil B. Smith, Engr., Confederation Life Bldg., Toronto, Ont., for a power-house to cost $40,000 have been rejected and it has been decided to accept plans prepared by Mr. Smith for an $8,000 structure," is incorrect. We are officially advised that the Light, Power & Telephone Commission, W. P. Cooke, Chn., Port Arthur, has adopted plans prepared by Mr. Smith and will receive bids according to his specifications. The dams will be of concrete construction and will cost $60,000.

BOISSEVAIN, MAN.—Bids are asked until noon, Sept. 28, by G. C. Smith, Town Clerk, for the supply of an electric lighting plant and all equipment. Alternative bids may be made for either a gas producer plant or steam plant. Plans and specifications may be seen at the Municipal offices and also at the office of W. E. Skinner, Consult. Engr., Somerset Bldg., Winnipeg, Man.

VICTORIA, B. C.—Bids are asked until Oct. 5 by W. W. Northcott ,City Purchasing Agent, for supply and installation of an electric equipment; also for the supply and installation of a steam driven pumping equipment.

## BRIDGES.

(* *denotes that this work is advertised in Engineering News.*)

BOSTON, MASS.—We are officially advised that the NEW ENGLAND STRUCTURAL CO., 110 State St., Boston, was awarded the contract on Sept. 10 by the city for rebuilding the Massachusetts Ave. bridge, at $22,342. Other bidders were: Boston Bridge Works, 47 Winter St., Boston, $27,174; H. P. Converse & Co., 88 Broad St., Boston, $27,849. William Jackson is City Engr.

ALBANY, N. Y.—Bids were received by F. C. Stevens, Supt. Pub. Wks., on Sept. 9 for furnishing and erecting three bridge superstructures over the Cayuga Inlet at Ithaca, the bridges to be located at (a) State St.; (b) Seneca St.; (c) Buffalo St. The bids were as follows: Montour Steel Co., Montour Falls, N. Y., (a) $8,983, (b) $6,810, (c) $6,810; Penn Bridge Co., Beaver Falls, Pa., (a) $11,240, (b) $8,970, (c) $8,970; McClintic-Marshall Construction Co., Pottstown, Pa., (a) $7,000, (b) $5,700, (c) $5,700; Groton Bridge Co., Groton, N. Y., (a) $8,534, (b) $7,162, (c) $7,162; Lewis F. Shoemaker & Co., Harrison Bldg., Philadelphia, Pa., (a) $8,765, (b) $6,994, (c) $6,994; UNITED CONSTRUCTION CO., 467 Broadway, Albany, N. Y., (a) $7,461 or $7,365 (alternate designs), (b) $6,274, (c) $6,274 (awarded contract). Designs and plans were also called for and submitted with the proposals.

BUFFALO, N. Y.—The McCLINTIC-MARSHALL CONSTRUCTION CO., Park Bldg., Pittsburg, Pa., has received the contract for the structural steel for the viaduct to be erected by the New York Central R. R. Co. and the Grade Crossing Commission of Buffalo over the New York Central R. R. Belt Line at Kensington Ave. The Terry & Tench Co., 131st St. and Lexington Ave., New York, will erect same. Contracts for eleven other steel structures required for the abolishment of grade crossings on the company's belt line will be placed shortly from that company's offices at New York City.

The EYRE SCHUMACHER CO., Philadelphia, Pa., now engaged in executing a $2,000,000 contract with the New York Central R. R. Co. and the Grade Crossing Commission for grade crossing subways and track elevation on the New York Central belt line, has been awarded an additional contract for the construction of concrete abutments for bridges, etc., in connection with the grade crossing work.

CALDWELL, N. J.—The Road Committee of the Board of Chosen Freeholders on Sept. 8 awarded contracts for the masonry work for the new concrete, steel-beamed bridge over Green Brook, Caldwell, to JAMES T. BOYLAN, of Belleville, N. J., at $3,392.

NORRISTOWN, PA.—Bids are asked until Sept. 26 by the County Commissioners, Norristown, Benj. F. Penrose, Chn., for constructing a highway bridge over Stony Creek, Norristown. John H. Dager is Engr.

SCRANTON, PA.—Bids are asked until Sept. 21 by E. A. Jones, County Audr., Lackawanna County, for painting and planking certain bridges.

WEST CHESTER, PA.—Bids are asked until Sept. 23 by the Commissioners at West Chester, Wm. Stevens, Chn., for constructing a reinforced concrete bridge in Easttown Township at Waterloo Mills.

WASHINGTON, PA.—Bids are asked until Sept. 23 by the County Commissioners, Washington, H. R. Campbell, Ch. Clk., for constructing a plate girder bridge, 63½ ft. long and 18 ft. wide over Chartiers Creek, Canton Township, at Hayes Ave., the floor to be of concrete brick on concrete masonry, Wm. Wylie, 2d Jefferson Ave., is Co. Engr.

UNIONTOWN, PA.—Bids are asked until noon, Sept. 21, by the County Commissioners for the construction of concrete abutments and wing walls for a bridge over Jennings Run, on the line of Menallen and North Union Townships. Charles L. Davidson is Clk.

POTTSTOWN, PA.—Bids were opened by the County Commissioners on Sept. 9 for the erection of the new county bridge over the Manatawny Creek here, as follows: Willour & Co., substructure, $19,850; L. H. Focht & Son, superstructure, $42,800; James M. Smith, complete, $55,316; York Bridge Co., York, Pa., complete, $34,405; L. F. Shoemaker, complete, $37,700; Charles T. Eastburn, complete, $40,600; John T. Hallman, substructure, $22,875; McClintic-Marshall Co., Park Bldg., Pittsburg, Pa., complete, $36,525; Toledo-Massillon Bridge Co., Toledo, Ohio, complete, $34,250.

*MONONGAHELA, PA.—Bids were received as follows on Sept. 10 by the County Commissioners for the construction of a bridge over the Monongahela River here. For the superstructure: King Bridge Co., Cleveland, Ohio, $178,000; McClintic-Marshall Construction Co., Park Bldg., Pittsburg, Pa., $175,670; Fort Pitt Bridge Works, Pittsburg, Pa., $163,900; American Bridge Co., 42 Broadway, New York, $240,130; Pennsylvania Steel Co., Philadelphia, Pa., $192,800; Mt. Vernon Bridge Co., Mt. Vernon, Ohio, $189,300; Penn Bridge Co., Beaver Falls, Pa., $189,465; Strobel Steel Construction Co., Chicago, Ill., $210,000; Toledo-Massillon Construction Co., Toledo, Ohio, $188,450.

MIAMI, FLA.—The Dade County Commissioners have awarded the contract to P. H. ROPER to grade, rock and construct bridges on the Stuart Jupiter road at $5,750.

MEMPHIS, TENN.—The Union Railway Co. has had plans prepared for the construction of a concrete bridge over Gayoso bayou at Front St.

ELYRIA, OHIO.—Bids are asked by the Board of Public Service until noon, Sept. 21, for furnishing 6,000 cu. yds. of earth filling for the new East Broad St. bridge. Rose Moriarity is Clk.

CINCINNATI, OHIO.—Bids are asked until noon, Oct. 9, by the County Commissioners for the construction of a bridge. Stanley Struble is Pres.

CLEVELAND, OHIO.—Bids are asked until 11 a. m., Oct. 3, by the County Commissioners for the construction of bridge work. A. B. Lea is County Surv.

Bids are asked until noon, Sept. 22, by A. R. Callow, Secy. Bd. Pub. Ser., for the removal of old roadway stringers and erecting new track stringers on the Abbey Ave. S. W. viaduct.

GREENVILLE, OHIO.—Bids are asked by the Board of Commissioners of Darke County until Sept. 19 for the construction of two concrete bridges. Plans, etc., may be seen at the office of the County Auditor. James E. Marker is County Surv.

ASHLAND, OHIO.—Bids are asked by the Board of Commissioners of Ashland County until noon, Sept. 30, for the construction of the W. E. Paulin bridge, a 50-ft. steel superstructure, with stone abutments and approaches, in Lake Township. C. W. Westover is County Audr.

*CINCINNATI, OHIO.—Bids are asked by the Board of Trustees of the Cincinnati Southern Ry., Ingalls Bldg., until noon, Oct. 12, for the construction of the superstructure of the viaduct for the terminal track from Eighth St. and McLean Ave. to Third and Front Sts., in accordance with the plans, profiles and specifications and forms of contract on file in the office of the Board of Trustees. Plans, profiles, detail drawings, specifications and estimated quantities can be secured on and after Sept. 15 at the office of Ward Baldwin, Ch. Engr.

CROWN POINT, IND.—We are officially advised that contracts were awarded as follows on Sept. 8 by the County Commissioners: Forsyth Ave. bridge to PAUL MAHLER; arch culvert, Cedar Creek Township, to E. H. CROWELL. Charles A. Johnson is County Audr.

TERRE HAUTE, IND.—Bids are asked until 11 a. m., Sept. 26, by the County Commissioners for constructing a bridge, a culvert and repairing a bridge. Nathan G. Wallace is County Audr.

*OTTAWA, ILL.—Bids are asked until 7 p. m., Oct. 6, by the Mayor and Council for the construction of the substructure and superstructure work of the Illinois River bridge here. James F. Farrell is Mayor.

*CHICAGO, ILL.—See under Miscellaneous Contracts.

BELVIDERE, ILL.—The City Council has awarded to the JOLIET STEEL & CONSTRUCTION CO., Joliet, Ill., the contract for a bridge at Main St., at $6,085.

LEAVENWORTH, KAN.—The County Commissioners have let the contract for the Wells bridge over Big Stranger Creek to the LEAVENWORTH BRIDGE CO., at $5,000.

MUSKOGEE, OKLA.—Bids are asked by the County Commissioners, until 10 a. m., Sept. 18, for the erection of 19 bridges in various parts of Muskogee County. W. E. Hooper is County Clk.

CENTRALIA, WASH.—Bids are asked by the Board of County Commissioners of Lewis County until Sept. 19 for constructing pile trestles, wing wall, two concrete abutments and an 80-ft. span steel bridge across the Skookumchuck River, about three miles north of here.

STOCKTON, CAL.—Bids are asked until Oct. 6 by the Board of Supervisors of San Joaquin County for construction of the Hunt bridge and Paradise Cut bridge. Estimated cost, $9,000 and $17,000, respectively. F. E. Quail is County Engr.

## BUILDINGS.

*(* denotes that this work is advertised in Engineering News.)*

PITTSFIELD, MASS.—BECKWITH & PIKE, of Pittsfield, have secured the contract for erecting the Center Grammar School in Pittsfield for $59,818.

*FORT ANDREWS (Boston post-office), MASS.—Bids are asked until 10 a. m., Oct. 15, by Capt. Ira L. Fredendall, Constr. Q. M., 263 Summer St., Boston, Mass., for the construction, including plumbing, heating, electric wiring and fixtures, of one single set Field Officers' quarters, one 5-set Bachelor Officers' quarters, two double sets N. C. O. quarters and one barrack for one company of Coast Artillery, at Fort Andrews, Peddocks Island, Boston Harbor, Mass.

*MERIDEN, CONN.—Bids are asked until 3 p. m., Oct. 2, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for an electric push button mail lift in the U. S. post-office, Meriden, Conn.

HARTFORD, CONN.—The contract for the construction of the State Library and Supreme Court building, bids for which were received Sept. 8, was awarded Sept. 11 to MARC EIDLITZ & SONS, 489 Fifth Ave., New York, for $924,000. Donn Barber, 24 East 23d St., New York, and E. T. Hapgood, Hartford, are Archs.

NEW YORK, N. Y.—Bids are asked until 2.30 p. m., Sept. 23, by Robert W. Hebberd, Comr. of Public Charities, for furnishing all the labor and materials necessary for additional heating, Children's Hospital, Randalls Island the City of New York.

Plans have been filed for six 5-story apartment houses to be erected on 116th St., by Harris and Abraham Cohen, 168 Park Row. The total cost of the structures will be $240,000. Charles B. Meyers, 1 Union Sq., is Arch.

Samuel Lipman, 14 East 108th St., will erect a 6-story apartment house, 50 × 87 ft., to cost $46,000, at 65 Bank St. Charles B. Meyers, 1 Union Sq., is Arch.

NEW YORK, N. Y.—We are officially advised that N. Serracino, Arch., 1123 Broadway, has let contract to THOMAS J. WATERS, 217 West 125th St., for a building composed of church, school and residence, to be built at West 151st St., between Seventh Ave. and Macomb's Pl., New York. Rev. Thomas F. Murphy is Rector.

Harry T. Howell, Arch., 534 Willis Ave., is preparing plans for two tenements to be erected in the Bronx by Samuel Williams. One at the corner of Courtlandt Ave. and 151st St., 59 × 100 ft., to cost $55,000, and the other on the east side of Washington Ave., 199.10 ft. north of 169th St., to cost $45,000.

We are officially advised that the PITTSBURG BUILDING CO., of Pittsburg, Pa., has the contract to remodel the Hotel Sarmac, Broadway, between 41st and 42d Sts., owned by the U. S. Restaurant & Realty Co. Henry C. Pelton, 10 East 33d St., is Arch.

*WEST POINT, N. Y.—Bids are asked by the Quartermaster until noon, Sept. 29, for erection of brick stables and construction of storm sewer at West Point.

CORNING, N. Y.—Bids are asked until Sept. 22 by the Board of Education for constructing a 2-story brick school here, to cost $55,000. Otis Dockstader, 101 North Church St., Elmira, N. Y., is Arch.

FORT SLOCUM (New Rochelle post-office), N. Y.—Bids for constructing complete addition to hospital at Fort Slocum, N. Y., were received by the Constructing Quartermaster, Fort Slocum, N. Y., on Sept. 3, as follows: David Buist, Bernardsville, N. J., plumbing, $4,450; Charles E. Currier Co., 110 Summer St., Boston, Mass., construction proper, $33,771; University Construction Co., 535 West 112th St., New York, construction proper, $47,000; Joseph N. Trapp, 17 Thames St., New York, construction proper, $40,498; Laurence J. Wright, 103 Park Ave., New York, construction proper, $39,097; Glen Engineering Construction Co., 156 Fifth Ave., New York, construction proper, $38,423; John New & Son, New Rochelle, N. Y., construction proper, $39,099; Kelly & Kelley, 45 East 42d St., New York, construction proper, $43,100; Harry McNally, 396 Broadway, New York, construction proper, $36,988; Earl & Cook Co., 150 Nassau St., New York, heating, $8,578; Isaac B. Merritt, Whitestone, N. Y., plumbing $6,400, heating $11,450; if both, plumbing, $6,250; heating, $11,356; Archibald & Lippoth, New Rochelle, N. Y., plumbing, $4,596; heating, $6,933; John Wood, 95 Fourth Ave., New York, plumbing, $3,874; M. B. Foster Electrical Co., 109 West 26th St., New York, wiring, $925; John Farrell, New Rochelle, N. Y., wiring, $1,390; fixtures, $583; Le Baron B. Johnson, 756 Liberty St., New York, wiring, $1,005; fixtures, $546.

PHILADELPHIA, PA.—It is stated that John Wanamaker will construct an extension to his store in Philadelphia, the addition to be built on the Chestnut St. side. An issue of $6,000,000 of bonds has been made.

We are officially advised that the contract for the William Penn High School, to be erected on the west side of 15th St., between Mt. Vernon and Wallace Sts., has been awarded to CRAMP & CO., Commonwealth Bldg., for $576,338. The original bid was $571,224, but with $21,514 for additional specifications the amount exceeded that available for the purpose. The immediate expense of construction was reduced by eliminating several items, including refrigerator plant, elevators, wardrobes, and substituting reinforced concrete for iron in the specifications for the roof. The school will be 200 × 240 ft., fireproof, of brick and limestone construction and four stories high. The trimmings will be of limestone instead of terra cotta. By these changes the bid was brought down to $576,338, there being $578,000 available. The contract calls for the completion of the building within ten months after the agreement is signed. Following is a list of the bids received on Sept. 8 by the Committee on Property of Board of Education: Cramp & Co., Commonwealth Bldg., $571,224; Lynch Bros., Lippincott Bldg., $586,810; James G. Doak & Co., 1420 Chestnut St., $588,430; David Peoples, Betz Bldg., $593,313; John R. Wiggins & Co., Heed Bldg., $600,000; Sax & Abbott, Hale Bldg., $611,183; J. E. & A. L. Pennock, Land Title Bldg., $622,348; Edward F. Fonder Co., Land Title Bldg., $623,450; Roydhouse, Arey & Co., 22d and Ludlow Sts., $634,935; Krug Constr. Co., German-American Trust Bldg., $698,000. J. H. Cook is Supt. Bldgs., Bd. of Public Education, City Hall.

JAMES G. DOAK & CO., 2185 East Norris St., have been awarded a contract for the erection of the police and patrol station at the corner of 19th and Oxford Sts. The two buildings, to take the place of the 23d District station on Jefferson St., above 20th St., will cost $60,402. The police station will be a 3-story brick structure, with a stone base, facing on Oxford St. The patrol house will front on Turner St., in the rear.

Work is to be started at once upon alterations and improvements on the Union League club house, Broad and Sansom Sts., to cost $650,000. Horace Trumbauer, Land Title Bldg., is Arch.

HARRISBURG, PA.—The State Commission for the erection of a Hospital for the Criminal Insane has awarded a contract to GEORGE A. GLENN & CO., 930 North Eighth St., Philadelphia, for a 3-story ward building at Fairview, Wayne County, to cost $121,480. This will be the first work in connection with the plan of erecting this institution. As outlined, the various groups of buildings for which appropriations will be asked from the next Legislature will amount to more than $2,000,000, and will take at least two years to build. Henry F. Walton is Chn. of Comm.; J. C. M. Shirk, 421 Chestnut St., Philadelphia, is Arch. Noted last week.

PITTSBURG, PA.—James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., has awarded contract for the construction of a Marine Hospital building at Pittsburg, Pa., to HENRY SHENK CO., Pittsburg, at $91,188. Time, July 31, 1909.

We are officially advised that the plans for the East Liberty Y. M. C. A. are ready for estimates, as follows: General contract, steel contract, plumbing, heating, ventilating, and wiring. Pittsburg contractors are preferred. Thomas Hannah, Diamond Bank Bldg., Pittsburg, Pa., is Arch.

Herbert L. May, Fifth and Market Sts., and associates, will erect a 12-story loft, store and office building at Liberty and Fifth Aves. The structure will have steel frame, stone, terra cotta and light-colored vitrified brick exterior. It will measure 31½ ft. on Liberty Ave. by 112½ ft. on Fifth Ave., the area per floor being 3,500 sq. ft. The contract has been let to the A. & S. WILSON CO., 541 Third Ave. Charles Bickel, 524 Penn Ave., Pittsburg, is Arch. Cost, $200,000.

PITTSBURG, PA.—The contract for the construction of the Marine Hospital on the Pittsburg Arsenal property has been awarded by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., to the HENRY SHENK CO., Lewis Block, at $91,188. The company is to complete the work by July 31, 1909.

HAGERSTOWN, MD.—Bids are asked until 3 p. m., Oct. 8, by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for complete construction of a U. S. post-office here.

FORT HOWARD (Baltimore post-office), MD.—Bids will be received until Oct. 9 by First Lieutenant S. C. Cardwell, Coast Artillery Corps, U. S. A., Constr. Q. M., Ft. Howard, for the construction of a barrack building and two double sets of N. C. O. quarters and the plumbing, heating and electric wiring of each building.

BALTIMORE, MD.—The C. A. Gambrill Mfg. Co., Charles C. Macgill, Pres., 309 Exchange Pl., has awarded contract to CHARLES L. STOCKHAUSEN, National Marine Bank Bldg., Baltimore, to erect a 4-story warehouse at Pratt and Commerce Sts. Parker, Thomas & Rice, Union Trust Bldg., are Archs. Cost, $50,000.

WASHINGTON, D. C.—A permit has been issued for the 9-story granite office building, which is to be erected by the D. S. Evans Estate at 1427 New York Ave., N. W., at a cost of $266,000. F. D. Pyle is Arch., 1003 F St., N. W., and G. A. FULLER CO., Home Life Bldg., are the contractors.

RICHMOND, VA.—The contract to erect an addition to the State Library has been let to J. T. NUCKOLS, 1111 East Main St., at $76,710.

PETERSBURG, VA.—Bids were received on Aug. 19 by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building in Petersburg, Va. The contract has just been let to W. M. SEAY & SON, Lynchburg, Va., at $69,225. Noted on Aug. 27.

*FORT MONROE, VA.—The following bids were received on Sept. 3 at the office of Constructing Quartermaster, Fort Monroe, Va., for the construction, etc., of library, barracks, N. C. O. and firemen's quarters, Fort Monroe, Va., as follows:

Construction—Item (1), library, (2) barracks, (3) N. C. O. quarters, (4) firemen's quarters: George Ittner, Atlanta, Ga., (1) $61,375, (2) $63,785, (3) $9,490, (4) $12,794; Thompson-Starrett Co., Washington, D. C., (1) $43,779; (2) $51,199; (3) $7,126; (4) $9,917. George A. Fuller Co., Washington, D. C. (1) $42,000, (2) $46,500, (3) $7,500, (4) $5,000 each; A. S. Reed & Bro. Co., Wilmington, Del., (1) $41,749, (2) $63,287 (3) $8,467, (4) $4,789, each; J. H. Binson, Hampton, Va., (1) $38,270, (2) $49,570, (3) $5,470, (4) $4,270, each; R. H. Richardson & Son, Hampton, Va., (1) $40,738, (2) $45,969, (3) $6,594, (4) $4,089, each.

Plumbing and Heating—(1) Library, (2) barracks, (3) N. C. O. quarters, (4) firemen's quarters: Nicholas Heating & Plumbing Co., Columbus, Ohio, (1) plumbing $1,119, heating $2,632; (2) plumbing $6,381, heating $5,829; (3) plumbing $906; (4) plumbing $1,442. Newport Plumbing & Heating Co., Newport News, Va., (1) plumbing $884, heating $2,059; (2) plumbing $5,815, heating $5,430; (3) plumbing $607, heating $460; (4) plumbing $1,211. W. G. Morris, Proebus, Va., (1) plumbing $782, heating $1,863; (2) plumbing $6,442, heating $4,963; (3) plumbing $583, heating $483; (4) plumbing $578. King Heating Co., Washington, D. C., (1) heating $2,045; (2) heating $4,706. Charles T. Taylor, Hampton, Va., (1) plumbing $1,048, heating $2,100; (2) plumbing $6,175, heating $6,259; (3) plumbing $590; (4) plumbing $598. Healy Plumbing & Heating Co., St. Paul, Minn., (1) plumbing $1,430, heating $2,252; (2) plumbing $6,136, heating $4,464; (3) plumbing $1,184, heating $488; (4) plumbing, $2,222. York Engineering Co., York, Pa., (1) heating $2,544; (2) heating $3,285. Harry A. Miller, Wilmington, Del., (1) plumbing $578, heating $2,135; (2) plumbing $5,698, heating $5,044; (3) plumbing $890; (4) plumbing $1,808. Sanitary Construction Co., Newport News, Va., (1) plumbing $647, heating $2,363; (2) plumbing $5,836, heating $7,272; (3) plumbing $552, heating $397; (4) plumbing $1,250.

Electrical Work—(1) Library, (2) stack room, (3) barracks, (4) N. C. O. quarters, (5) firemen's quarters: Coburn & Cooke, Newport News, Va., (1) $1,094, (2) $344, (3) $1,444, (4) $294, (5) $368; S. J. Watson, Jr., Hampton, Va., (1) $1,485, (3) $1,596, (4) $314, (5) $382; York & Boothby, Portland, Me., (1) $1,385, (2) $520, (3) $2,335, (4) $465, (5) $247; W. Drummond Marrow, Greensboro, N. C., (1) $1,750, (2) $400 (3) $1,375, (4) $250, (5) $200.

*ROANOKE, VA.—Bids are asked until noon, Sept. 22, by W. E. Thomas, Clerk of Council, for supplying metal furniture necessary for various vaults. W. B. Bates is City Engr.

ATLANTA, GA.—Bids are asked until 10 a. m., Oct. 1, by R. V. Ladew, Supt. of Prisons and Prisoners, Dept. of Justice, Washington, D. C., for furnishing and delivering at the U. S. Penitentiary, Atlanta, Ga., steel channels to be used in construction of the main east and west cell wings.

JACKSONVILLE, FLA.—We are officially advised that the Utica Investment Co., E. G. Phinney, Pres., has awarded the contract to MANHATTAN CONSTRUCTION CO., 70 William St., New York, N. Y., to erect Commercial Bank Building, to have ten stories and basement, 100 × 105 ft., first two stories and basement of stone, remaining stories of brick. Cost, about $400,000.

LEXINGTON, KY.—The contract for erecting new High School has been awarded to COMBS LUMBER CO., of Lexington, at $53,795. Bids were received on Sept. 3. J. O. H. Simrall is Clerk Bd. of Education.

YOUNGSTOWN, OHIO.—We are officially advised that the general contract has been let to JOSEPH MILLHAM, of Youngstown, by C. C. & A. L. Thayer, Archs., Lawrence Savings & Trust Bldg., New Castle, Pa., for the Masonic Temple, to be erected in this city, at a cost of $125,000. The building will be seven stories high, of brick, stone and steel construction, and will cover a ground plan 64 × 153 ft. The structure will have systems of fan ventilation, plumbing and heating, two elevators, marble interior decorations, etc. The architects will prepare the plans, take bids and award all contracts. The fireproofing contract has been let to the EXPANDED METAL FIREPROOFING CO., 541 Wood St., Pittsburg.

The contract to erect a library has been awarded to HELLER BROS., West End Raven Ave., at $103,616. The building is to be of reinforced concrete and limestone. Owsley & Boucherle, Wick Bank Bldg., are Archs.

HARVEY, ILL.—Bids are asked by David Wiedeman, Cashier, First National Bank, until 4 p. m., Oct. 12, for the erection of a bank, store, office and flat building. I. W. Kelley is Arch., 79 Dearborn St., Chicago, and Chicago Heights, Ill. Frederic R. De Young is Pres.

NORTH CHICAGO, ILL.—No bids were received on Sept. 15 in answer to an advertisement issued by the Bureau of Navigation, Navy Department, Washington, D. C., for the construction of six buildings, consisting of a commandant's house, four officers' houses, and a receiving guardhouse at the Naval Training Station, Great Lakes, North Chicago, Ill. The Bureau probably will readvertise for bids.

RHINELANDER, WIS.—C. H. Tegen, Arch., Manitowoc, has let general contract to GEORGE RICKMAN & SONS CO., Kalamazoo, Mich., for a 2-story court-house for the Oneida County Board, A. Taylor, Chn., Rhinelander. Cost, $100,000.

KENOSHA, WIS.—Bids were received as follows on Sept. 10, at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at Kenosha Wis.: J. P. Cullen Co., Janesville, Wis., $51,655; Herbert T. Hazelton, Chicago, $60,185; General Construction Co., Hathaway Bldg., Milwaukee, Wis., $64,400; Majestic Construction Co., Appleton, Wis., $54,904; Charles Hertz & Son, Grand Rapids, Mich., $66,566; K. P. Knudsen, Kenosha, Wis., $65,500; Northern Construction Co., 421 Milwaukee St., Milwaukee, Wis., $61,800; Bedford Stone & Construction Co., Indianapolis, Ind., $59,000; Charles W. Gindele, 3333 La Salle St., Chicago, $59,950; Barnes Bros., Hamilton, Ohio, $54,350; J. F. Schmidt Bros. Co., Reaper Block, Chicago, $56,804; Northwestern Construction Co., Wahpeton, N. Dak., $57,299; Sterling Engineering & Construction Co., Milwaukee, Wis., $54,800; J. L. Simons, Chicago, $63,411.

FERGUS FALLS, MINN.—Bids are asked by the State Board of Control, P. M. Ringdal, Chn., until Sept. 28, for the general construction of a 2-story pressed brick and cut stone addition to the State Insane Asylum at Fergus Falls, Minn. It will have steam heating, electric lighting and modern plumbing, and will be fireproof throughout. C. H. Johnston, Manhattan Bldg., St. Paul, is Arch. Cost, $65,000.

ST. PAUL, MINN.—J. H. Wheeler, Arch., 1016 New York Life Bldg., city, has awarded the contract for superstructure of the refectory, chapel and dormitory of St. Agatha's Conservatory, Exchange and Cedar Sts., to J. H. HOFFMAN, 340 Carroll Ave., St. Paul. His bid was $72,679.

LA MOURE, N. DAK.—Buechner & Orther, Archs., Manhattan Bldg., St. Paul, Minn., have awarded the contract for the superstructure of the court-house here to R. K. HAFSOS, Aberdeen, S. Dak., at $62,150.

SHERIDAN, WYO.—The following bids were received on Sept. 9 by James Knox Taylor, Supervy. Arch., Treasury Dept., Washington, D. C., for the construction of the U. S. post-office at Sheridan, Wyo.: Ferguson-Pearson Co., Sheridan, Wyo., $146,800, no time stated; J. H. Weise, South Omaha, Neb., $131,420; time, Dec. 31, 1909.

DILLON, MONT. — The CAMPBELL BUILDING CO., Dooly Block, Salt Lake City, Utah, has secured the contract to construct the $50,000 depot for the Oregon Short Line at this point and has sent workmen here to begin breaking ground for the building. It will be constructed of concrete and be rustic style. J. P. Congdon, Supervy. Engr. of the Short Line, has received instructions from the general offices to begin the work of changing the tracks in the railroad yards in the city to correspond with the plans for the new depot. The main track will be located east of all sidings.

JEFFERSON BARRACKS, MO.—Bids are asked by Capt. O. W. Bell, Q. M., until 11 a. m., Sept. 30, for constructing a double set of H. C. Sergeants' quarters, including plumbing, electric wiring and lighting fixtures.

ST. LOUIS, MO.—The projected La Salle building at the corner of Olive St. and Broadway will be built. Plans have been prepared and approved by the syndicate interested in the construction, the contract has been let and ground will be broken within the next few days. The building will be 13 stories high and will be fireproof. It will cost $220,000, constructed of reinforced concrete and brick, with terra cotta trimmings. The building will be 28 × 102 ft., covering the entire space of ground at that corner. The contract was awarded on Sept. 9 to the C. L. GRAY CONSTRUCTION CO., Victoria Bldg. Isaac S. Taylor, Syndicate Trust Bldg., is Arch. W. H. Miltenberger, A. M. Frumberg, Vital Garesche, D. Breaden and L. W. Hall, members of the syndicate which will own the structure. Estimated cost, $400,000.

ST. LOUIS, MO.—Bids were received as follows Sept. 14, at the office of James Knox Taylor, Supervy. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office building at St. Louis: Charles McCaul Co., 17th and Diamond Sts., Philadelphia, $1,088,175; Hill-O'Meara Construction, Syndicate Bldg., St. Louis, $1,140,500; John Peirce Co., 90 West St., New York, $979,000; E. A. Steininger Construction Co., Victoria Bldg., St. Louis, $1,019,980; Bedford Stone & Construction Co., Indianapolis, $966,000; C. L. Gray Construction Co., Victoria Bldg., St. Louis, $1,071,191; Hiram Lloyd Bldg. & Construction Co., St. Louis, $1,027,000; James Stewart & Co., Lincoln Trust Bldg., St. Louis, $1,013,430; P. M. Hennessey Construction Co., St. Paul, $1,013,500; John Gill & Sons, Citizens' Bldg., Cleveland, Ohio, $975,000. Time to complete, July 1, 1910.

SAN MARCOS, TEX.—FISCHER & LAMBIE, of Austin, Tex., have been awarded the contract for the Hays County Court-House at San Marcos. Cost, $60,000.

MINERAL WELLS, TEX.—Bids will be received until Sept. 19 at the office of L. C. Schenck, Arch., Ft. Worth, Tex., for erecting a 2-story, 100 × 200-ft. brick and fireproof building at Mineral Wells for the Crazy Wells Co. Bids are to be submitted separately for the wiring, plumbing and steam heating. Estimated cost, $60,000.

DALLAS, TEX.—No bids were received Sept. 9 at the office of James Knox Taylor, Supervy. Arch., Treasury Dept., Washington, for furnishing a boiler equipment for the post-office at Dallas, Tex.

VANCOUVER BARRACKS, WASH.—Bids are asked by the Constructing Quartermaster until 11 a. m., Oct. 2, for the construction of a 2-story addition to Building No. 63 and for certain other construction work; also for furnishing and installing plumbing fixtures in Buildings Nos. 62, 63, 64, 68 and [illegible].

SEATTLE, WASH.—Plans and specifications have been prepared by Breezor Bros., Archs., for the Leary Building, to be built at Second Ave. and Madison St. The structure to be erected this year will be 108 × 120 ft., and will cost about $400,000. There will be 115 offices in the building and the ground floor will be fitted up for the National Bank of Commerce and L. L. Moore. The bank interior fittings will cost from $75,000 to $100,000. L. L. Moore will put in fittings that cost about $30,000. The building will have seven elevators. The stairways will be of marble. The JAMES BLACK MASONRY & CONSTRUCTION CO., Wright Bldg., St. Louis, Mo., are the builders.

SAN FRANCISCO, CAL.—Seven bids for the construction of the City and County Infirmary were received by the Board of Works on Sept. 2; that of the Condon McGlynn Co., 789 Mission St., at $119,100, being the lowest. The award will be made Friday after the proffers have been considered by the City Architect and the Board of Health. The bids received were: The Ferrolite Co., $145,000; the New York Reinforced Concrete Construction Co., $137,180; Rickon-Eckhart Engineering & Construction Co., $134,659; Healy-Tibbetts Construction Co., $164,723; Thompson-Starratt Co., $136,945; J. J. O'Brien Construction Co., $168,176; the Condon-McGlynn Co., $119,100. Newton Thorp is City Arch.

Application has been made on behalf of the Bangers' Investment Co. for a permit to erect a $200,000 building on the corner of Grant Ave. and Geary St. on plans furnished by William Mooser, Arch., Union Trust Bldg. The structure is to be four stories in height and class A, steel, stone, terra cotta and brick being the material to be used. The building is to be used for commercial purposes.

H. L. Peterson has applied for a permit to erect a 6-story building for store and loft purposes on the site of the old Sanborn & Vail building, on the south side of Market St., 350 ft. east of Fourth St. The structure is to cost $100,000 and the material is to be reinforced concrete. T. Paterson Ross is Arch., 222 Kearny St.

SAN FRANCISCO, CAL.—Bids were received as follows on Sept. 15, at the office of Col. F. L. Denny, Q. M., U. S. Marine Corps, Washington, D. C., for the construction of officers' quarters and marine barracks at Yerba Buena Island, San Francisco Bay, Cal.: Millar, Lauson & Walters, 660 Market St., (a) officers' quarters, (b) marine barracks, (a) and (b) $43,210. W. A. McLean, Chronicle Bldg., (a) $15,350; (b) $31,000. Charles King & Co., Lick Bldg., (a) $15,546; (b) $32,781. Caldwell & Co., 969 Fell St., (a) $14,873; (b) $41,700. Lindgren Co., (a) $15,525; (b) $29,000. G. Hazelton Wilson, 3420 19th St., (a) $14,049; (b) $31,803. Stockholm & Allyn, Builders' Exchange Bldg., (a) $16,790; (b) $39,970. Beehan & Hinds, 709 Polk St., (a) $13,283; (b) $33,010. Hoyt Bros., Santa Rosa, Cal., (a) $15,398; (b) $37,449. Richard McCann, Belmont, Cal., (a) $12,083; (b) $26,963. Delmar Smith, Kohl Bldg., (a) $15,885; (b) $32,747. J. A. Baumann, 3d and Mission Sts., (a) $13,850; (b) $39,479. Keating-Bradford Co., 3 O'Farrel st., (a) $15,116; (b) $30,694. Charles Wright, 2243 15th St., (a) $16,547; (b) $38,299. All bidders of San Francisco unless otherwise specified.

SACRAMENTO, CAL.—Bids are asked until 2 p. m., Sept. 25, by William Hamilton, County Clerk, for the erection and completion of a new county jail building, situate in the block bounded by I and J, Sixth and Seventh Sts., City of Sacramento. R. A. Herold, Bryte Bldg., Sacramento, is Arch.

PHOENIX, ARIZ.—Bids are asked until Sept. 19 by James J. Riggs, Secy. Bd. Control, for erecting a hospital for the Territorial Asylum for the Insane near Phoenix. Probable cost, $45,000.

FORT WILLIAM, ONT.—CARTER, HALLS & ALDINGER, of Winnipeg, Man., have been awarded the contract for erecting a $100,000 office building at Fort William, Ont. The building is being erected for E. H. Cuthbertson, and will be fireproof throughout. Darling & Pearson, Canada Life Bldg., Winnipeg, are Archs.

WINNIPEG, MAN.—The contract for the new Y. W. C. A. building, Winnipeg, has been let to CARTER, HALLS & ALDINGER of this city, the contract price being $85,000. In the gymnasium will be a suspended running track built of reinforced concrete.

A theater costing $40,000 will be built here by William G. Gillman. Plans are being prepared by W. Melville, Union Bank Bldg., Winnipeg. The building will seat 900 people. Work is to be commenced on its erection this month. The building is to be 56 ft. on Main St. and 120 ft. on Jarvis St. and the one balcony will hold seating for some 400 to 500 people. It will have a frontage of pressed brick and will be fireproof. The ground floor on Main St. will be occupied by stores with office suites over the lobby. A separate gallery entrance will open on Main St.

## WATER SUPPLY—IRRIGATION.

*(* denotes that this work is advertised in Engineering News.)*

WOLFEBORO, N. H.—The contract for furnishing the water pipe for the new "wild line" of the Wolfeboro water-works system has been awarded to R. D. WOOD & CO., 400 Chestnut St., Philadelphia.

*SPRINGFIELD, MASS.—We are officially advised that bids were received on Sept. 9 by the Board of Water Commissioners for furnishing and laying about twelve miles of 42-in. pipe: Steel pipe: Booth & Flynn, Ltd., 1942 Forbes St., Pittsburg, Pa., $444,038; Ryan, Fox & Hennington, Springfield, $487,947; T. A. GILLESPIE CO., 90 West St., New York, $428,025 (awarded contract); James H. Holmes Co., 87 Nassau St., New York, $575,995; Riter-Conley Mfg. Co., Pittsburg, $400,880, $419,591 (w.-i. pipe); Robert C. Storrie, Philadelphia, $477,200; Petroleum Iron Works Co., Sharon, Pa., $472,461 Fred T. Ley Co., Springfield, $494,244. Cast-iron pipe and specials: Ryan, Fox & Harrington, $447,150; U. S. Cast-Iron Pipe & Foundry Co., 71 Broadway, New York, $471,200; Camden Iron Works, Camden, N. J., $465,375; Warren Foundry & Machine Co., 111 Broadway, New York, $484,880. Hauling and laying 61,300 ft. of 42-in. pipe, 3,000 cu. yds. rock excavation, Westfield River crossing and other crossings: Booth & Flinn, $210,038; Ryan, Fox & Harrington, $207,544; Robert C. Storrie, $216,225; Fred T. Ley & Co., $137,100; Loring N. Farnum Co., 53 State St., Boston, Mass., $134,187; William F. Norton, 215 West 125th St., New York, $169,920; Falvey & Kelly, 15 Rush St., Somerville, Mass., $210,830; General Contracting Co., 1234 Henry Clay Ave., New Orleans, La., $418,950.

The following bids were received for 1,821 ft. of 54-in. steel pipe, the contract stating that the first 62 lengths of pipe, beginning at the West Parish filters shall be of 54-in. steel: Canton Boiler & Engineering Co., Canton, Ohio, $10,790; Carroll-Porter Boiler & Tank Co., Pittsburg, Pa., $11,300; Cruse-Kemper Co., Ambler, Pa., $11,400; Elba Iron Mfg. Co., 816 Perry Bldg., Philadelphia, Pa., $12,650; Edwin Burhorn, 71 Wall St., New York, $12,937; Standard Boiler & Plate Iron Co., Niles, Ohio, $13,494; P. Delaney & Co., Newburg, N. Y., $13,500; E. E. Lochridge is Ch. Engr.

*WRENTHAM, MASS.—Bids are asked until 8 p. m., Oct. 1, by the Board of Water Commissioners of Wrentham, for construction of a roof to standpipe to be constructed of wood or metal. E. F. McClennen is Secy.

*STAMFORD, CONN.—Bids were received as follows on Sept. 10 by the Stamford Water Co., 125 Atlantic St., Stamford, for the construction of a dam, together with other works necessary to the enlargement of the reservoir: A. B. Griswold, New Britain, Conn., $103,045; Godwin Construction Co., 30 Church St., New York, $108,765; E. G. Bangs, New York, $114,532; R. K. Everitt & Co., Tarrytown, N. Y., $115,504; Boston & New York Contracting Co., 220 Devonshire St., Boston, Mass., $117,745; New York Continental Jewell Filtration Co., 15 Broad St., New York, $118,480; Bunting, Bull Co., Lever Bldg., Flushing, N. Y., $122,100; C. W. Blakeslee & Sons, New Haven, Conn., $123,322; O'Brien Construction Co., Waterbury, Conn., $122,320; R. W. Sherman, Utica, N. Y., $125,770; Arthur McMullen, Stamford, Conn., $127,710; John O. Merritt Co., Portchester, N. Y., $129,320; J. B. Malatesta, 3169 Jerome Ave., New York, $130,925; R. E. Boggs, Charlottesville, Va., $131,617; Richards & Gaston, 143 Liberty St., New York, $134,825; Tucker & Vinton, 103 Park Ave., New York, $139,345; Coleman Bros., 15 Court St., Boston, Mass., $143,215; Russell Contracting Co., 156 Fifth Ave., New York, $147,098; United Engineering & Contracting Co., 32 East 33d St., New York, $149,959; F. Wardwell, Stamford, $153,210; Decicco Contracting Co., Larchmont, N. Y., $167,145.

ALBANY, N. Y.—Bids are asked by F. C. Stevens, Supt. Public Works, until noon, Oct. 1, on Barge Canal Contract No. 55, which is for constructing a reservoir dam on the Mohawk River; relocating a portion of the Black River Canal; building four locks and performing all other work appertaining thereto; area of reservoir inside clearing line being about 4.8 miles; engineer's estimate, $1,014,525. And on Contract No. 61, which is for the improvement of the Erie Canal from the west end of Contract No. 60 to the west line of Monroe County, a distance of 7.39 miles; engineer's estimate, $1,000,219. Frederick Skene is State Engr. and Surv.

NEW YORK, N. Y.—Bids are asked until 3 p. m., Sept. 24, by the Park Board for furnishing, delivering and laying new water mains and appurtenances in Central Park, between 81st and 100th Sts., in the Borough of Manhattan, the City of New York.

NEW YORK, N. Y.—Bids are asked until 2.30 p. m., Sept. 23, by the Department of Public Charities for furnishing all the labor and materials necessary to lay the mains and install a pressure system, and to put in operation all the steam and water fixtures now in the new Nurses' Home, Metropolitan Hospital, Blackwell's Island. Robert W. Hebberd is Comr.

FLUSHING, L. I., N. Y.—Bids are asked by C. B. J. Snyder, Supt. School Bldgs., New York, until Sept. 21, for the installation of a water supply system for the buildings of the Parental School, Flushing, Borough of Queens.

*ALLEGHANY, N. Y.—Bids are asked until 8 p. m., Sept. 29, by the Board of Trustees for the construction of a system of water-works requiring approximately the following materials: Four miles of 10, 8, 6 and 4-in. c.-i. pipe, 55 hydrants, 40 gate-valves, two gas engines and triple power pumps, brick pumping station, etc. F. W. Forness, Jr., is Pres.

GARFIELD, N. J.—Bids were opened as follows by the Mayor and Borough Council on Sept. 4, for extending the water distribution system and for the erection of a steel standpipe. Contracts were awarded as follows: For extension of water pipes, to GEO. SARGENT, Jr., at $11,300; steel standpipe, 30 × 45 ft., to TIPPETT & WOOD, Phillipsburg, N. J., at $5,469; and for pump and boiler house and reinforced-concrete pump pit and reservoir, to SARGENT & WARREN, at $7,000. Colin R. Wise is Boro. Engr., 34 Bloomfield Ave., Passaic, N. J.

PASSAIC, N. J.—Bids are asked by the Committee on Water Supply, in care of the City Clerk, until Oct. 30, for distributing, laying, etc., about 37 miles of 6 to 20-in. pipe, hydrants, gate valves, specials, etc., furnishing and delivering same, and furnishing a new water supply from 3,000,000 to 12,000,000 gallons per day to be taken from wells or surface streams.

*VERONA, N. J.—Bids are asked until 8 p. m., Oct. 28, by the Committee of Water Supply, William A. Smith, Chn., for constructing a system of water-works in the Borough of Verona. Walter E. Sexton, 46 North Twelfth St., Philadelphia, Pa., is Engr.

*HADDONFIELD, N. J.—Bids are asked until 8 p. m., Oct. 6, by Hon. J. Morris Roberts, Mayor, for constructing a water-works system here. Allen Clymer is Boro. Clerk; George Pfeiffer, Jr., 27 Market St., Camden, N. J., is Engr.

HOPEWELL, N. J.—We are officially advised that the McGOVERN CONTRACTING CO., of Trenton, N. J., has been awarded the contract for extensions to the water-works and sinking wells, at $10,350. Bids were opened on Sept. 10. Charles A. Hague, 52 Broadway, New York, is Engr.

BALTIMORE, MD.—Bids were opened on Sept. 2 by the Board of Award, J. Barry Mahool, Pres., for furnishing and erecting a pump slip indicator on each of the six pumping engines in the service of the Water Board. The contract has been awarded to the PETOMETER CO., 220 Broadway, New York, N. Y. Alfred M. Quick, Water Engr.

The Board of Awards on Sept. 2 awarded contracts for supplying valves to the Water Board to the COFFIN VALVE CO., of Neponset, Mass., and the RENSSELAER VALVE CO., of Troy, N. Y., at a total cost of about $8,000.

CHRISTIANSBURG, VA.—[illegible] voted the issuance of $25,000 [illegible] bonds.

CANTON, N. C.—Bids are a[illegible] 20 by the town for the constru[illegible] works. J. W. Scott is Town [illegible]

CLARKSDALE, MISS.—C[illegible] awarded on Aug. 25 by the M[illegible] men as follows: To WEBER [illegible] Tenn., for concrete steel chi[illegible] ENGINE CO., Erie, Pa., for 5[illegible] to CROCKER-WHEELER C[illegible] J., for 300-KW. direct-conne[illegible] Walter G. Kirkpatrick, Jack[illegible] Engr.

BARBOURSVILLE, KY.—T[illegible] ville Water-Works Co. will i[illegible] works system here, for wh[illegible] been completed.

CHAGRIN FALLS, OHIO.—B[illegible] until noon, Oct. 14, by the Tr[illegible] lic Affairs for laying 4-in. w[illegible] appurtenances in Fenkall Ave[illegible] Orchard St. and Solon Road. [illegible] man is Clk.

ROCKVILLE, IND.—Bids w[illegible] Aug. 26 by the Town Board f[illegible] to include brick pumping sta[illegible] tical boilers, two horizontal dupl[illegible] capacity of 170 gallons per min[illegible] about 2¼ miles of 6 to 8-in. c[illegible] contract was awarded to T. A [illegible] of Olney, Ill., at $12,457; [illegible] were: Watson & Sons, Terre [illegible] $13,876; Olds Construction Co., [illegible] $14,609; Standard Construction [illegible] Ill., $14,955; A. E. Werkhoff, [illegible] $16,727; E. J. Coleman, Rockvill[illegible] 924; A. Schori, Peoria, Ill., $17[illegible] Strouse is City Engr.

OWOSSO, MICH.—The contract for installing two Scotch marine boilers f[illegible] works has been awarded to YOUNG & SUMMERS, of Toledo, Ohio, at $6,500. Bids were opened on Aug. 26.

HOSPERS, IOWA.—The contract for constructing water-works, bids opened on Aug. 20, has been awarded to the DES MOINES BRIDGE & IRON CO., of Des Moines, at $7,150. The power-house and well will be constructed by the town. J. W. Klein is Town Clk.

FORT DODGE, IOWA.—The contract for the new pump for the pumping station was awarded on Aug. 31 by the city to the CANTON-HUGHES CO., of Canton, Ohio, at $7,975.

ALBERT LEA, MINN.—Bids are asked by C. J. Dudley, City Clerk, until 8 p. m., Sept. 28, for the construction of 2,700 ft. of 6-in. water mains.

ST. PAUL, MINN.—Bids are asked by the Board of Water Commissioners, John Caulfield, Secy., until Sept. 21, for constructing an embankment around the artesian wells at Centreville.

BONNER SPRINGS, KAN.—The contract for constructing water-works, bids opened on Sept. 4, has been awarded to J. J. DONNEGAN CONSTRUCTION CO., of Shenandoah, Iowa, at $21,000. D. Clarke Kelly is City Clk.

*WINFIELD, KAN.—Bids are asked until 3 p. m., Sept. 30, by George W. Sloan, City Clk., for constructing water-works improvements, separate bids being entertained as follows: (1) For concrete settling basins, filter house, filter chambers, piping around filters, drains, etc.; (2) for furnishing and laying c.-i. and w.-i. supply line, constructing pump pit, furnishing and installing electrically driven pump and motor; (3) for furnishing and installing all filter equipment; (4) for furnishing and installing all of the above complete under one contract.

ABERDEEN, S. DAK.—Bids are asked until 8 p. m., Sept. 21, by F. W. Raymond, City Audr., for constructing an 8-in. artesian well.

STICKNEY, S. DAK.—Contracts for constructing the water-works system have been awarded as follows: For 6-in. well, to A. V. DEPUE, of Plankinton, S. Dak., at $1.75 per ft.; remainder of system to SYKES, STILLWELL & REDAL, as follows: 6-in. c.-i. water main, 70 cts.; 4-in. c.-i. main, 55 cts.; specials, 3½ cts. per lb.; hydrants, 90-ft. steel tower, 40,000-gallon cypress, pumping station, machinery valves, hydrants, etc. Bids were opened on Aug. 22. Dakota Engineering Co., of Mitchell, S. Dak., are Engrs.

HOPE, ARK.—Bids are asked until Oct. 6 by the Board of Water-Works Improvements, Dist. No. 1, E. S. Greening, Jr., Secy., for furnishing material and constructing a system of water-works, consisting of a surface reservoir about 70 × 35 × 12 ft. of reinforced concrete and about 900 tons of c.-i. pipe, together with hydrants, valves, etc. J. A. Omberg, Jr., is Engr., Goodwyn Bldg., Memphis, Tenn.

*HOUSTON, TEX.—Bids are asked until 3 p. m., Oct. 19, by the Water Department for the complete installation of a 15,000,000-gallon pumping engine at the water plant. H. B. Rice is Mayor.

TULSA, OKLA.—The following bids were opened on Aug. 17 for the construction of a clarification basin for the water-works to be 200 ft. long, 120 ft. wide and 17 ft. deep: (a) Western Construction Co., Kansas City, Mo., (b) American Light & Water Co., Kansas City, Mo.; (c) Municipal Construction Co., Muskogee, Okla.; (d) New State Construction Co., Tulsa: 14,865 cu. yds. excavation, (a) 30 cts., (b) 27 cts., (c) 2[illegible] cts., (d) 24 cts.; 1,516 cu. yds. puddle cla[illegible] (a) $5, (b) $3, (c) $3, (d) $2.87; 2,185 cu. yds. concrete reinforced, (a) $13.75, (b) $[illegible], (c) $13.30, (d) $12; 157 cu. yds. concrete not reinforced, (a) $6.50, (b) $8.15, (c) $8[illegible], (d) $7.20; 50.76 cu. ft. lumber sheeting, (a) $44, (b) $40, (c) $35, (d) $33.20. T. C. Hughes is City Clk.

DENVER, COLO.—We are officially advised that the contract for grading the canal on the Snake River for the Routt County Development Co. has been awarded to the NORTHWESTERN CONSTRUCTION CO.

SEATTLE, WASH.—The contract for laying water-mains in East 50th and other streets has been awarded by the city to E. T. SMART & CO.

MONTREAL, QUE.—Bids are asked by L. O. David, City ... until noon, Sept. 22, for the construction of ... pump foundations, building foundations, ... masonry and brick work, joinery, palating, ... lumber, roofing and glazing necessary for the ... construction of a building to be erected at the Low Level Pumping Station, Point ... Charles.

## SEWERAGE.

*(* denotes that this work is advertised in Engineering News.)*

ALBANY, N. Y.—See item under Streets and Roads.

*WEST POINT, N. Y.—Bids are asked until noon, Sept. ... by the Quartermaster for the construction of a storm brick sewer here.

BINGHAMTON, N. Y.—Bids will probably soon be asked by the Board of Contract and Supply for the construction of the Lewis St. sewer.

ONEIDA, N. Y.—Bids will soon be asked by the Board of Public Works for the construction of a sewer in Central Ave. about 400 ft. long.

RIDGWAY, PA.—M. APPLEGATE & SON, of Alliance, Ohio, have been awarded the contract of a sewerage system, bids opened Aug. 31, at $5,000. G. Greiner is Boro. Secy.

*DANVILLE, PA.—Bids are asked until noon, Sept. 30, by the Trustees of the State Hospital for the Insane for the construction of a sewage disposal plant; and also for a 6-ft. concrete main to carry a run from the Hospital grounds to the river. William F. Shay is Pres. Dr. H. B. Meredith is Supt.

ELDRED, PA.—W. H. SIMPSON of Olean, N. Y., has been awarded the contract for a system of sewerage here.

WESTEND, PA.—Bids are asked until 8 p. m., Sept. 21, by the Borough for the construction of a sewer system as follows: 15-in. sewer, 1,000 lin. ft.; 12-in. sewer, 2,864 lin. ft.; 10-in. sewer, 250 lin. ft.; 6-in. sewer, 2,100 lin. ft. S. C. Jones is Boro. Clk.

McADOO, PA.—The contract for constructing sewers here, for which six bids were received, has been awarded by the Town Council to LUDWIG KRAMER at $12,178. The highest bid was $20,642.

FOREST CITY, PA.—The contract for the construction of 18,000 lin. ft. of sewer here has been awarded to the WESTMORELAND CONSTRUCTION CO., of Greensburg, Pa.

LATROBE, PA.—WILLIAM GIBSON, of this city, has been awarded the contract for the construction of the new sewer in John St.

PAINT, PA.—Council has awarded D. A. MALONE, of Hollidaysburg, Pa., the contract for laying 3,000 lin. ft. of terra-cotta sewer here.

*BALTIMORE, MD.—Bids are asked by the Board of Awards, until 11 a. m., Oct. 14, for constructing sewage disposal works. J. Sewell Thomas is City Register.

WASHINGTON, D. C.—We are officially advised that the contract for the construction of the East Side interceptor sewer, near Bladensburg Road, has been awarded to the WARREN F. BRENIZER CO., Second and O Sts., Washington, at $16,000.

Bids are asked by the Commissioners of the District of Columbia until noon, Sept. 28, for reconstructing portions of the Rock Creek and B St. intercepting sewer.

WASHINGTON, D. C.—Bids were received as follows on Sept. 14 at the office of the Commissioners of the District of Columbia for the construction of Section C of the east side intercepting sewer, Boundary to Brookland: (a) E. G. Gummel; (b) James A. Coyle, (c) Brennan Construction Co.; (d) Warren F. Brenizer Co., all of Washington; (e) Sherwood Engineering Co., York, Pa.: Ordinary excavation (a) 79 cts.; (b) 70 cts.; (c) $1.25; (d) 95 cts.; (e) 67 cts; sewer brick masonry, (a) $14; (b) $18; (c) $15; (d) $14; (e) $20; invert brick masonry, (a) $18; (b) $22; (c) $20; (d) $20; (e) $22; concrete masonry "D," (a) $7.75; (b) $8; (c) $11.90; (d) $9; (e) $8; 6-in. pipe, (a) 20 cts.; (b) 30 cts.; (c) 40 cts.; (d) 30 cts.; (e) 30 cts.; totals, (a) $16,841; (b) $17,010; (c) $25,222; (d) $19,777; (e) $16,949.

Bids were also received as follows for two vertical compound engines at the sewerage pumping station: Shepherd Engineering Co., Williamsport, Pa., $5,126; Sturdevant Co., Hyde Park, Mass., $5,690; Ball Engine Co., Philadelphia, $8,944.

TAMPA, FLA.—The city has awarded the contract to B. L. DAVIS, of Tampa, for constructing the storm sewer in Jackson St.

PASCAGOULA, MISS.—The city on Sept. 3 awarded the contract for laying sewers, paving and curbing and laying sidewalks to PIERSON & RICHARDSON, of Meridian, Miss., at $26,782.

NASHVILLE, TENN.—The Board of Public Works has awarded the contract to CURTIS & LE SUEUR of Nashville for constructing a trunk sewer in Crutcher and South Fifth Sts.

MURFREESBORO, TENN.—The city has awarded the contract to GRANBERRY JACKSON, Nashville, Tenn., for making a survey of streets and preparing plans and specifications for the construction of a sewer system.

*LOUISVILLE, KY.—WEBER & CO., Chicago, Ill., have been awarded the contract by the Sewerage Commission for the construction of Section D of the southern outfall sewer system at $186,000. Bids were opened on Aug. 21. Noted last week.

J. F. Breed, Ch. Engr., Sewerage Comm., is preparing plans for the construction of Section E of the same system. Bids will soon be asked.

DAYTON, OHIO.—The Board of Public Service has awarded the contract to HECKER & KIRCHNER for the construction of sanitary sewers here at $14,027. Noted last week. T. N. Pexton is Pres. Bd.

The only bid received on Sept. 4 by the Board of Public Service for cleaning the Lorain Ave. and other storm water sewers in the East End was that of W. H. Stewart, at $9,985.

LORAIN, OHIO.—The lowest bid opened by the Board of Public Service on Sept. 5 for the construction of the Oberlin Ave. storm sewer was that of Faragher & Randall.

EAST LIVERPOOL, OHIO.—Bids are asked by the Board of Public Service at the office of the Board until noon, Sept. 22, for the construction of a 6-in. sanitary sewer with 4-in. lateral connections, manholes and flush tank on Sheridan Ave., from Chestnut St. to the intersection of Sheridan Ave. and Lisbond St. A. H. Hughes is Clk.

CORLETT (Cleveland post-office), OHIO.—Bids are asked until noon, Oct. 6, by W. H. Jantzen, Village Clk., for the construction of sewers in various streets.

ASHTABULA, OHIO.—Bids have been received as follows by the city for the construction of the West Prospect and Nathan St. sewer: F. J. Eichenlaub, $6,616; J. J. Farrell & Co., Ashtabula, $6,344; Hukari & Johnson, Ashtabula, $5,469; J. T. Clark, Ashtabula, $4,834; S. A. Haskell, Painesville, $4,628; E. F. MAYBACH, Collinwood, Ohio, $3,999 (awarded contract). Lewis A. Amsden is City Engr.

*OXFORD, OHIO.—Bids are asked by the Council until noon, Sept. 29, for the construction of sanitary sewers here. The work consists of approximately the following amounts: 40,400 lin. ft. of 8-in., 7,000 lin. ft. of 10-in., 10,000 lin. ft. of 12-in., 3,500 lin. ft. of 15-in. sewer; 120 manholes, 29 lampholes; 29 flush tanks; 11,410 lin. ft. excavation under 5 ft.; 22,682 lin. ft. excavation, 5-7 ft.; 11,815 lin. ft. excavation, 7-9 ft.; 2,540 lin. ft. excavation, 9-11 ft.; 2,070 lin. ft. excavation, 11-13 ft.; 870 lin. ft. excavation, 13-15 ft.; together with all necessary Y branches, and appurtenances, according to plans and specifications on file. D. P. Boaton is Clk.

TWO RIVERS, WIS.—Bids are asked until 8 p. m., Sept. 18, by the Board of Public Works for the construction of a portion of the sewer system.

DAVENPORT, IOWA.—Bids for sewer construction were opened by the city on Sept. 1 and the contracts were awarded to P. CONNELLY, who was the lowest bidder. The new sewers and the bids were as follows: Prairie st., from Division to a point 200 ft. west: Davenport Construction Co., 74 cts.; Hydraulic Concrete Construction Co., 68 cts.; P. Connelly, 60 cts. Hamilton St., from Marquette St. to a point 300 ft. east: Davenport Construction Co., $1.10; Hydraulic Concrete Construction Co., $1.18; P. Connelly, $1.07. Division St., from Prairie to a point 300 ft. south: Davenport Construction Co., 75 cts.; Hydraulic Concrete Construction Co., 78 cts.; P. Connelly, 60 cts. Thomas Murray is City Engr.

DES MOINES, IOWA.—THE COOK CONSTRUCTION CO., of Des Moines, has been awarded the contract for 12 and 10-in. sewers on Ninth St., Wright Ave., Eighth St. and Penn. Ave., about 4,418 ft.; eleven manholes in East Des Moines; also for 1,890 ft. 10 and 12-in. sewers on University Ave., 37th St. and Cottage Grove Ave. in West Des Moines. George D. Dobson is City Engr.

VINTON, IOWA.—D. E. KEELER of the Peoples Construction Co., of Davenport, Iowa, has been awarded the contract for the sewer which is to be laid in Vinton this fall, at $7,236.

BONNER SPRINGS, KAN.—The contract for constructing a sanitary sewer system, bids opened Sept. 4, has been awarded to MICHAEL WALSH, of Kansas City, Mo., at $16,000.

FORT LEAVENWORTH, KAN.—Bids are asked until 11 a. m., Sept. 23, by Capt. William D. Davis, Constructing Q. M., U. S. A., for the construction of approximately 960 ft. of 6-in. sewer and connections to three double sets Lieutenants' quarters, two manholes and approximately 216 ft. of 1¼-in. water connections to same buildings, at Fort Leavenworth.

HOPE, ARK.—Bids are asked until Oct. 6 by the Board of Sewer Commissioners, Improvement District No. 1, E. S. Greeneing, Jr., Secy., for furnishing material and installing a system of sanitary sewers. J. A. Omberg, Jr., is Engr., Goodwyn Bldg., Memphis, Tenn.

WELLAND, ONT.—Bids are asked until 8.30 p. m., Sept. 19, by the Town Clerk for the construction of a trunk sewer. G. R. Boyd is Acting Clk.

## GARBAGE DISPOSAL.

*(* denotes that this work is advertised in Engineering News.)*

FORT ANDREWS (Boston post-office), MASS.—Bids for the construction of a garbage crematory and building at Fort Andrews Mass., were received by Capt. Ira L. Fredendall, Quartermaster, U. S. A., Boston, Mass., on Aug. 25 as follows: Item (1) crematory building; (2) crematory; (3) both building and crematory; (4) brick chimney: Decarie Incinerator Co., Minneapolis, Minn., (1) $2,900, (2) $12,888; Hapgood, Frost & Co., Wellesley, Mass., (1) $1,993; the Dixon Engineering & Constructing Co., Toledo, Ohio, (2) $6,000; the Universal Destructor Co., New York, (1) $2,350, (2) $2,950, (3) $4,980, (4) $1,200; Moore-Boulger Destructor Co., New York, (1) $1,700, (2) $2,250; Lewis & Kitchen, Chicago, Ill., (1) $2,470, $2,470, $3,970 and $4,000; (2) $1,930, $2,542, $2,220 and $2,250; (3) $4,000, $5,880 and $4,400; (4) $650.

NEW CASTLE, PA.—The NEW CASTLE GARBAGE CO., of this city, has been awarded the contract for the collection and disposal of the city garbage and refuse for another year.

YOUNGSTOWN, OHIO.—C. C. FISHER, of York, Pa., has been awarded the contract for the collection and disposal of the city garbage for the next year at $2.90 per ton. There were four other biddera.

SEATTLE, WASH.—The ALLIS-CHALMERS CO., Milwaukee, Wis., has been awarded the contract by the Board of Park Commissioners for the installation of a stone crusher at Franklin, at $6,500. The stone crusher is to have a capacity of 2,000 yds. a day and the stone will be used in the construction of the Lake Washington Boulevard. Two other bids were received for the machinery needed.

## STREETS AND ROADS.

*(* denotes that this work is advertised in Engineering News.)*

BANGOR, ME.—Bids are asked until 2 p. m., Sept. 19, by the Mayor and Street Engineers for constructing a section of State road about 2,510 ft. in length. John F. Woodman is Mayor.

HAVERHILL, MASS.—W. F. DUFFEE & CO. were awarded the contract on Sept. 2 by the Street Committee for granolithic sidewalks at $1.50 per sq. yd.

MARBLEHEAD, MASS.—The Board of Selectmen on Sept. 3 awarded the contract for reconstructing Atlantic Ave. to McDONOUGH & CO., of Swampscott, Mass., at $5,636.

SOUTHINGTON, CONN.—The contract for constructing about 16,000 sq. yds. of macadam road in the borough limits has been awarded to C. W. TRYON, of Meriden, Conn. The borough will do all grading work and the contractor will apply the macadam treatment. It is approximated that 5,000 tons of trap rock will be used, and the contractor will be paid at the rate of $1.50 per ton. Bids were opened on Aug. 27. Samuel H. McKenzie is Boro. Engr.

HARTFORD, CONN.—Contract for the construction of State road work, bids for which were opened at the office of the State Highway Commissioner on Sept. 8 have been awarded as follows: Town of Suffield, 1,315 lin. ft. macadam, to OLMSTED & OLMSTED, East Hartford, at $1.21 per lin. ft. Other bidders were: Board of Selectmen of Town, $1.90; A. D. Bridge's Sons, Hazardville, $1.95; O. T. Benedict, Pittsfield, Mass., $2.50. Town of North Canaan, 3,680 lin. ft. combined macadam road, with telford base, to SELECTMEN OF TOWN, at $1.15 for macadam and $1.50 for telford. No other bidder. One 24-in. and one 15-in. tile culvert required on work. Town of Trumbull, 2,700 lin. ft. macadam-telford, on Newtown Turnpike, to T. H. GILL & CO., Winter Hill Station, Boston, Mass., $1.49 for macadam and $1.90 for telford. Other bidders were: O. T. Benedict, Pittsfield, $2.25 and $2.75; B. D. Pierce, Jr., Co., Bridgeport, $1.99 and $2.75. Town of Trumbull, 3,000 lin. ft. macadam, with combined gutters, on Huntington Turnpike, to same, at $1.95 for macadam and 75 cts. per sq. yd. for cob. Other bidders were: O. T. Benedict, Pittsfield, Mass., $2.35 and 90 cts.; B. D. Pierce, Jr., Co., Bridgeport, Conn., $2.22 and 65 cts. Two 15-in. tile culverts with strainer required on work. Town of Winchester, 4,461 lin. ft. macadam road, with combined gutters and retaining wall, to LANE CONSTRUCTION CO., Meriden, at $1.66 for macadam, 60 cts. per sq. yd. for cobblestone gutters and $6 per cu. yd. for wall. Other bidders were: O. T. Benedict, Pittsfield, Mass., $1.99, 90 cts. and $6; Pierson Engineering & Construction Co., Bristol $2.20, 60 cts. and $6; Joseph Mascetti, Torrington, $2.30, 50 cts. and $5.50; T. H. Gill Co., Boston, Mass., $2.35, 75 cts. and $5. One 24-in., one 18-in. and one 15-in. tile culverts required on work. Town of Granby, 5,700 lin. ft. macadam and telford road, to A. BRIDGE'S SONS, Hazardville, $1.44 for macadam and $1.89 for telford. Other bidders were: Connecticut Contracting Co., Hartford, $2.11 and $2.81; O. T. Benedict, Pittsfield, $1.79 and $2.25; Pierson Engineering & Construction Co., Bristol, $1.90 and $2.40; Lane Construction Co., Meriden, $1.60 and $2.10; F. Arrigoni & Bro., Durham, $1.85 and $2.40; T. H. Gill Co., Boston, $1.68 and $2.08. Two 15-in. tile culverts required on work. Town of Granby, 4,700 lin. ft. grading with 6-in. hardening top, with railing and culvert, to F. ARRIGONI & BRO., Durham, at $5,000 for road work and $600 for culvert. Other bidders were Connecticut Contracting Co., Hartford, $8,883 and $525; Amos Bridge's Sons, Hazardville, $6,800 and $2,000; O. T. Benedict, Pittsfield, $5,500 and $800; Pierson Engineering & Construction Co., Bristol, $5,400 and $700; Lane Construction Co., Meriden, $5,500 and $900; T. H. Gill Co., $7,976 entire. Town of Killingly, 3,235 lin. ft. gravel road on main highway from Danielson to the TOWN, at $1.05 per lin. ft. J. A. Gilbert. Town of Danbury, 935.5 lin. ft. macadam-telford road on Park Ave., to O. T. BENEDICT, Pittsfield, Mass., at $1.78 per lin. ft. for macadam and $2.22 per lin. ft. for telford. This includes about 50 ft. of rubble drain. Town of Willington, 800 lin ft. rubble drain and telford road, with a 12-in. tile culvert to the T. H. GILL CO., Boston, Mass., at $1.50 per lin. ft. Also 150 lin ft. shallow drainage, with 4-in. tile and telford construction to the same contractor at $1.50 per lin. ft. Town of Lisbon (Jewett City post-office), 800 lin. ft. gravel road on the Norwich Turnpike, to T. H. GILL CO., Boston, Mass., at $1.28 per lin. ft. Town of Guilford, 2,000 lin. ft. gravel-telford on Clapboard Hill, to F. ARRIGONI & BRO., Durham, Conn., at $1.20 per lin. ft.

HARTFORD, CONN.—Bids for the construction of state roads will be received at the office of the State Highway Commissioner, Capitol, until 2 p. m., Sept. 19, as follows: Town of Weston, 2,000 lin. ft. gravel telford road; town of Wethersfield, 1,400 lin. ft. macadam on Jordan Lane; town of Fairfield, 6,503 lin. ft. gravel on the Easton Turnpike; town of Westport, 4,777 lin. ft. gravel telford road; town of Newington, two sections, aggregating 10,835 lin. ft. macadam; also until 2 p. m., Sept. 21: Town of Sprague, 2,100 lin. ft. gravel on Lee Hill Road; town of Preston, 2,425 lin. ft. gravel on mainroad to Norwich; town of Montville, 2,100 lin. ft. macadam telford on main road from Uncasville to Oakville; town of Sprague, 2,100 lin. ft. gravel road.

NEWINGTON, CONN.—The contract for the construction of 16,375 lin. ft. of macadam and 2,100 lin. ft. telford road, with cob gutters, retaining wall and railing, on the Berlin turnpike in the town of Newington, has been awarded to FRANK ARRIGONI & BRO., Durham, Conn., at $2.15 per lin. ft. for macadam; $2.65 for telford; $1.10 per lin. ft. for rubble drain; $4.20 per cu. yd. for wall, and 35 cts. per sq. yd. for cobble gutters.

NEW YORK, N. Y.—Bids are asked until 3 p. m., Oct. 1, by the Park Board for repaving where directed the cement walks of small parks in the Borough of Manhattan, City of New York. Henry Smith is Pres. Bd.

ROCHESTER, N. Y.—The Board of Contract & Supply on Sept. 3 awarded contracts as follows: WHITMORE, RAUBER & VICINUS, 270 South Ave., Rochester, for trap rock pavement on Charlotte St., at $8,479; gravel pavement on Schaefer St., to HOLDER & BAUMAN, at $4,400.

WHITE PLAINS, N. Y.—E. L. ERBECK, of White Plains, has secured the contract for 4,300 yds. brick paving on 4-in. concrete base, at $2.48 per sq. yd.

TONY RICHARDS, of White Plains, secured the contract for 3,700 sq. yds. brick paving on 4-in. concrete base at $2.20 per sq. yd. Bids were opened on Aug. 17. James F. Goerke is Village Engr.

UTICA, N. Y.—Bids were opened on Sept. 2 by the Board of Contract and Supply for paving as follows: Barber Asphalt Paving Co., 131 Broad St., Kemble St., with asphalt and stone curb and sidewalks, $11,453; Neilson St., asphalt with cement curb and cement sidewalks, $9,235, and with stone curb and stone sidewalks $9,458; and Nchols St., asphalt with cement curb and cement sidewalks, $4,175, and stone curb and stone sidewalks, $4,275

BALDWINSVILLE, N. Y.—The Village Board of Trustees on Sept. 8 awarded the contract for paving Oswego St. to the intersection of Genesee and East Genesee Sts. from Oswego St. to the cross walk at the intersection of Lock St. to C. O. McCOMB at $11,006. The material to be used is Mack block and the curbing is to be of stone

*SARANAC LAKE, N. Y.—The Board of Trustees awarded the contract to ELDRIDGE & GRANNIS, of Ossining, N. Y., for paving Main St., Broadway, Bloomingdale Ave. and Depot St. with Mack brick and to build macadam roadways in Upper Broadway, East Main St., Church St., Flower Ave. and River St. List of bidders noted on Aug. 27.

ALBANY, N. Y.—Bids are asked by the Board of Contract and Supply until 3 p. m., Sept. 21, for the improvement of Orange St., from Chapel to Lark Sts., and for the improvement of Stanwix St., from Delaware Ave. to Second Ave., and for the improvement of North Pearl St., from North First St. to North Second St.; also for construction of vitrified pipe sewer in Garden St; in Erie, Champlain and North Sts., and for repairs to the Lark St. sewer. Isidore Wachsman is Secy. of Bd. Walter Mellus is City Engr.

*ROOSEVELT, N. J.—Bids are asked until 8 p. m., Sept. 21, by the Mayor and Common Council for the construction of 39,000 sq. ft. of concrete sidewalk and several hundred feet of concrete curb, according to plans and specifications prepared by F. F. Simons, Borough Engr., Carteret, N. J.

WESTCHESTER, PA.—F. W. BORNEMANN & CO., of Lansdowne, Pa., have secured the contract for constructing 20,360 ft. of state road in Penn Township.

ERIE, PA.—The contract for paving West Third St. was awarded on Sept. 3 by the Councils to J. J. and M. E. DOYLE, at $24,110.

McKEESPORT, PA.—J. W. BUTLER, of Portvue, Pa., has been awarded the contract by the Street Committee for repairing Shaw Ave. and paving Beaver St. between Evans Ave. and Federal St. Bids were opened on Sept. 8.

WILKES-BARRE, PA.—H. G. MULOCK CO., of Atlantic City, N. J., has secured the contract for 12,210 sq. yds. of brick paving and curbing on Hancock, Washington and Grant Sts., at about $25,000.

WASHINGTON, D. C.—Bids were opened on Sept. 3 by the Commissioners, District Columbia, for paving the roadway of Anacostia bridge and roadway of bridge across Baltimore & Ohio R. R. track on line of extension of Monroe St., Anacostia, about 3,525 sq. yds. sheet asphalt. The contract has been awarded to the BRENNAN CONSTRUCTION CO., of Washington, at about $5,000. C. B. Hunt is Ch. Engr. of Highways.

PORTSMOUTH, VA.—Bids are asked until Sept. 29 by the City Clerk and addressed to the Street Committee, E. B. Hawks, Chn., for furnishing material and paving with sheet asphalt, vitrified brick or bituminous macadam or bitulithic, portions of Lincoln and North Sts., and Middle St., in all about 14,700 sq. yds. paving, 7,800 lin. ft. 5-in. granite curb. Bascom Sykes is City Engr.

DUBLIN, GA.—The city has awarded the contract to the GEORGIA ENGINEERINO CO., Augusta, Ga., for 17,200 ft. of vitrified-brick paving at about $40,000. H. S. Jardon & Goss, Savannah, Ga., are Engrs.

*ATLANTA, GA.—Bids for the construction of macadam roadways, aggregating from 20,000 to 25,000 sq. yds., on Ponce de Leon Ave., Druid Hills, Atlanta, will be received by D. Lee Wardroper, C. E., Candler Bldg., Atlanta, until 3 p. m., Oct. 3.

TUSCUMBIA, ALA.—HAGER & MORRIS, Sheffield, Ala., have been awarded the contract for laying about five miles of concrete sidewalks here at $1.20 per sq. yd., or about $11,000.

SCRANTON (Pascagoula post-office), MISS.—The city has awarded the contract to PIERSON & RICHARDSON, Meridian, Miss., at $26,782, for constructing about 100,000 sq. ft. concrete sidewalk, 20,000 lin. ft. concrete combined curb and gutter and necessary crossings and culverts. Bids were opened on Sept. 2. Walter G. Kirkpatrick, Jackson, Miss., is Engr.

BROWNSVILLE, TENN.—W. B. TROY, Camden, Tenn., has been awarded the contract at 45½ cts. per sq. yd. for graveling about six miles of streets. The specifications call for an average of 6 ins. of gravel on Depot St. and 5 ins. on all other streets.

BLOUNTVILLE, TENN. — The KREIS-FRENCH CONSTRUCTION CO., Knoxville, Tenn., has been awarded the contract for grading and macadamizing about 25 miles of roads in Sullivan County. John H. Caldwell is Rd. Comr.; F. G. Phillips is Engr.

CHATTANOOGA, TENN.—The SOUTHERN PAVING CONSTRUCTION CO., First National Bank Bldg., Chattanooga, has submitted the lowest bid at $37,418 for paving Rossville Ave. with vitrified brick, curbing, etc.

UTICA, OHIO.—Bids were opened on Aug. 20 for paving Main St. with vitrified repressed paving brick by the city. The contract was awarded to SHOUP & CO., of Dayton, Ohio, at the following prices: 10,480 ft. curbing and gutter, 48 cts.; 5,132.42 cu. yds. excavation, 30 cts.; 18,054 sq. yds. rolling and pud, subgrade, 4 cts.; 18,054 sq. yds. 8-in. gravel, 24 cts.; 18,054 sq. yds. 2-in. sand, 4 cts.; 15,264 sq. yds. cement filler, 6 cts.; 15,265 sq. yds. Townsend block, 90 cts.; Total, $27,047. Other bidders on Townsend block were: Theo. W. Hill, Bellefontaine, $29,978; W. H. Ringwall, Chillicothe, $28,486; Adams Bros., Zanesville, $29,486; Hines & Bowlin, Frankfort, Ind., $28,598; W. S. Pace, Sandusky, $27,100; Harrison & Dean, Huntingdon, W. Va., $32,611; F. H. Kinney & Son, Newark, $31,018; W. H. Ralston, Mt. Vernon, $29,254; E. A. Freshwater Sons, Bucyrus, $30,291; Brennen & Nutter, Newark, $31,925; Geo. J. Brock & Son, Coshocton, $27,898; A. Wroe & Son, Dayton, $28,356. H. L. Maddocks, of Newark, Ohio, is Engr.

TOLEDO, OHIO.—H. P. STREICHER has been awarded contracts for paving portions of Glenwood Ave. and Putnam St. with sheet asphalt at $11,001 and $3,109 respectively.

S. J. PICKETT has secured the contract for paving a portion of Boody St. and the alley between Wakeman and Empire St., at $4,472 and $3,008 respectively. John M. Babcock is City Clk.

CARTHAGE, OHIO.—Bids are asked until noon, Oct. 10, by D. L. Sampson, Secy. Hamilton County Agricultural Society, for grading and constructing drains in the infield of the Fair grounds here.

CINCINNATI, OHIO.—The County Commissioners on Sept. 4 awarded the contract for the improvement of the Duck Creek road, from Cincinnati to the Deerfield road, to JOHN W. SHIELDS & BRO., at $38,008.

CINCINNATI, OHIO.—The County Commissioners on Sept. 8 awarded the contract for the improvement of Blue Ash Ave., from Cooper Ave. to the Plainfield pike, and Plainfield pike, from Blue Ash Ave. to Montgomery pike, to D. O. SCHMIDT, at $11,155.

NEWARK, OHIO.—Bids are asked until noon, Sept. 22, by the County Commissioners, for grading and macadamizing 1.55 miles of road in Lima Township. James C. Wonders is State Highway Comr.

CANTON, OHIO.—T. K. TURNBULL, of this city, has been awarded the contract for grading, curbing and paving East Lake St., from Belden Ave. to Grace St., at his bid of $8,071.

WARREN, OHIO.—WALDECK & READY, of this city, have been awarded the contract for the Vienna Ave. road and for the Canfield road leading into this city.

CHINNOCK BROS., of this city, have been awarded the contract for the construction of a road leading into the city.

F. L. GEIGER, of this city, has secured the contract for the Newton Falls roads, between this city and Deavittsburg, Ohio.

LIBERTY, IND.—Bids are asked by the Commissioners of Union County until 2 p. m., Oct. 5, for the construction of a gravel road in Harmony Township. Length of road 11,612 ft. Clinton Gardner is County Audr.

BLOOMINGTON, IND. — The INDIANA CREOSOTING CO. has been awarded a contract for furnishing 25,000 sq. yds. of creosoted paving block, requiring 25,000 ft. of pine timber.

DELPHI, IND.—The Commissioners of Carroll County have awarded contracts for gravel roads as follows: Road No. 1, THOMPSON & O'CONOR, Delphi, $3,300; road No. 2, O'CONOR & SON, Delphi, $1,645; road No. 3, E. F. PIERCE, Delphi, $5,990; No. 4, E. J. BARNARD, Delphi, $9,327; road No. 5, HALLORAN & HOVERSTICK, Noblesville, Ind., $10,587.

BEDFORD, IND.—The Commissioners of Lawrence County have awarded a contract for the construction of six miles of gravel road in Marshall Township to McNEE DUNN, of Anderson, at $18,000.

NEW CASTLE, IND.—The Commissioners of Henry County have awarded a contract for the construction of three miles of gravel road in Greensboro Township to ORB GEORGE, of Kennard, at $9,325.

MUNCIE, IND.—All bids opened on Sept. 8 for resurfacing the streets with brick have been rejected. New bids will be received until Sept. 25. Estimated cost $8,000. J. A. Jackson is City Clk.

SHELBYVILLE, IND.—The Board of County Commissioners has awarded to WILLIAM AERY, of Waldron, Ind., the contract for constructing the Halloren macadam road in Noble Township, 1½ miles in length, at $4,175.

DOWNERS GROVE, ILL.—Bids are asked until Sept. 17 by the Board Local Improvement, J. W. Hughes, Pres., for constructing a brick pavement, requiring about 29,563 cu. yds. earth excavation, 45,595 sq. yds. vitrified brick pavement, 33,196 lin. ft. of combined curb and gutter, etc. J. S. Lozier is Engr., Downers Grove.

FOND DU LAC, WIS.—GEORGE H. STANCHFIELD was awarded the contract for the Union and Military St. cement pavements by the Board of Public Works on Sept. 5, at $11,481.

CEDAR RAPIDS, IOWA.—The contract for improving North 7th St., bids opened on Aug. 28, has been awarded to McCARE & HOLLIS, Cedar Rapids, at $13,410. L. J. Storey is City Clk.

OTTUMWA, IOWA.—J. C. BLUNK, of Ottumwa, has secured the contract for 22,000 sq. yds. vitrified paving brick, one course laid on 6-in. Portland cement concrete, sand fill, and 11,000 ft. Portland cement curb, at about $50,000.

ST. PAUL, MINN.—Bids are asked until Sept. 17 by the Board Public Works, R. I. Gorman, City Clk., for resurfacing a portion of Sixth St. with asphalt.

HOT SPRINGS, ARK.—The city has awarded contracts for paving Malvern, Ouachita and Central Aves. to the SOUTHERN BITULITHIC CO., Nashville, Tenn., and RUDOLPH S. BLOME CO., 79 Dearborn St., Chicago, Ill., at about $100,000.

DALLAS, TEX.—JAMES GANO, of Dallas, has been awarded the contract at 25 cts. per cu. yd. for excavation work on Evergreen St.

MARSHALL, TEX.—The TEXAS BITULITHIC CO., Dallas, Tex., has secured the contract to lay pavements in Marshall at about $85,000.

OGDEN, UTAH.—Bids are asked until 8 p. m., Sept. 21, by the City Recorder for constructing sidewalks in sidewalk district No. 3, extension No. 4; sidewalk district No. 18, extension No. 3, and sidewalk district No. 21, extension No. 3. A. F. Parker is City Engr.

IDAHO FALLS, IDAHO.—The City Council on Aug. 28 opened bids for macadamizing the streets in local improvement district No. 2. The contract was awarded to E. P. HENRY and W. W. KEEFER, the lowest bidders, at $17,725.

TORONTO, ONT.—Bids are asked until noon, Sept. 22, by Joseph Oliver, Chn. Bd. of Control, for the construction of asphalt, bitulithic, vitrified block, brick and concrete pavements, concrete curbing and concrete walks.

NORTH TORONTO, ONT.—C. H. CONERY, Guelph, Ont., has been awarded the contract for laying cement sidewalks here at 13½ cts. per sq. ft.

## MANUFACTURING PLANTS.

*(* denotes that this work is advertised in Engineering News.)*

HARTFORD, CONN.—The Treey Steam Turbine Co. has awarded the general contract for a factory building, 200 × 82 ft., brick with concrete foundation to A. L. HILLS, 920 Main St., Hartford. The BERLIN CONSTRUCTION CO. will do the steel work. The building will contain steel construction for a 10-ton traveling crane.

PORT JEFFERSON, N. Y.—We are officially advised that Frederick L. Smith, Industrial Engr., 15 Beekman St., New York, is engaged on plans for a brick plant for the Dyett Sand-Lime Brick Co. It will have a daily output of 100,000 brick. The equipment will consist of brick-making machinery, curing cylinders, power plant, piping, belting, shafting, etc. The buildings will be of structural steel and corrugated iron siding.

NEW YORK, N. Y.—The Rapid Transit Construction Co. has filed plans with the Building Superintendent for the working outfit to be used by the company for the enlargement of the subway from 96th to 102d Sts. The construction plant is to be erected at Broadway and 97th St. and will comprise six buildings, consisting of a machine shop with a compressor room, a smithy, a carpenter shop, a supply house, an oil house and a cement shed and storage yard.

BUFFALO, N. Y.—The Standard Oil Co. 26 Broadway, New York, has filed plans for a 1-story pan-house of brick and steel which it will add to its local plant on Elk St. A receiving house of brick will be built also.

The E. J. Jones Co., manufacturers of steel balls for ball bearings, Military Road, north of Buffalo, is having plans prepared for a 2-story factory building of reinforced-concrete construction which it will erect in place of a portion of the plant recently destroyed by fire. It will rebuild the power-house which was partially destroyed. L. H. Detrick, 817 White Bldg., is Arch.

B. I. CROOKER, contractor, Builders' Exchange, has been awarded contract by the Board of Public Works, Francis T. Ward, Comr., for the erection of a brick and structural steel boiler house, 90 × 200 ft., one story, at the north pumping station at bid of $40,148.

NORTH TONAWANDA, N. Y.—The American District Steam Co., Chas. R. Bishop, Secy., Lockport, N. Y., has let general contract to LATHROP, SHEA & HENWOOD, Buffalo, for erecting a manufacturing plant at North Tonawanda. Estimated cost, $100,000. Noted on Sept. 3.

ERIE, PA.—Bids are asked until Sept. 19 by the Osborn Engineering Co., Osborn Bldg., Cleveland, Ohio, for erecting a machine shop, 100 × 100 ft., to be constructed of brick and structural steel, for the Erie Foundry Co.

PHILADELPHIA, PA.—WILLIAM STEELE & SONS, 1600 Arch St., have the contract for the erection of a 5-story cigar factory building for Bayuk Bros., 50 North Third St. Estimated cost, $50,000.

SPRING CITY, PA.—Bids are asked until 10 a. m., Oct. 2, by Hon. John M. Scott, 625 Walnut St., Philadelphia, to erect Building E, boiler, laundry machinery, etc., for the Institute for Feeble-Minded and Epileptics near Spring City, Pa. Philip H. Johnson, Land Title Bldg., Philadelphia, is Arch. J. F. Sherwood is Secy.

BALTIMORE, MD.—C. A. Gambrill Mfg. Co. 309 Exchange Pl., flour millers, is about to erect a new building in the eastern end of the New District. Parker, Thomas & Rice, Union Trust Bldg., are Archs. CHARLES L. STOCKHAUSEN, National Marine Bank Bldg., has contract. It will cost about $50,000 and will be four stories high.

NORFOLK, VA.—Bids are asked until 11 a. m., Oct. 3, by William M. Smith, Acting Ch. of Bureau of Yards and Docks, Navy Dept., Washington, D. C., for laundry equipment at the U. S. Naval Hospital, Norfolk. Specifications are on file at the office of Engineering News, New York.

COOLEEMEE, N. C.—It is reported that Charles Lefler and Owen Wolfe, of Salisbury, N. C., will arrange for the erection of a knitting mill at Cooleemee, N. C.

CHARLOTTE, N. C.—The Jewel Cotton Mills expect to arrange for the construction of its buildings this fall, and will install an initial equipment of 6,144 spindles and accompanying machinery, with the intention of doubling this plant in about a year. About $100,000 will be the cost of the first installation, and the product will be 60s to 100s two-ply combed yarns from long-staple cotton.

REEDY RIVER FACTORY (Greenville post-office), S. C.—The Reedy River Mfg. Co.'s plant at Reedy River Factory, S. C., was damaged by the recent floods. Its flume, 263 ft. long, was washed away and its machine shop was slightly damaged. Its weave room was submerged and all the machinery in this department will have to be dried and cleaned. The loss was probably $20,000. The damage will be repaired so that manufacturing can be resumed. The company has a plant of 12,000 ring spindles and 371 looms, producing drills and sheetings.

CORDELE, GA.—The Read Phosphate Co., Nashville, Tenn., will expend $20,000 in erection of buildings for phosphate plant. The contract has been awarded to HUGGER BROS., Montgomery, Ala., who will construct the entire plant, with the exception of chamber building, chambers, burner building and burners.

TAMPA, FLA.—The Tampa Fertilizer Co. has let contract to AULICK & DERATT for the erection of a fertilizer factory building, 380 × 80 ft. Cost, $12,000.

The Tampa Northern R. R. Co. has plans and contemplates beginning construction work on railway repair shops at Palmetto Beach, according to the "Manufacturers' Record." The four shop buildings will be erected of wood and covered with galvanized sheet-iron. The main building, to be erected at once, will be 90 × 200 ft., solid concrete foundation; estimated cost, $7,500. It will be equipped with boiler and dynamos and electrically operated. Three adjacent shops will cost $7,500; total cost of equipment estimated at $50,000. Work will be supervised by John Pasco, Ch. Engr., assisted by C. R. Knight, Engr.-in-Charge of erecting buildings, and W. J. McGee, Master Mechanic, in charge of furnishing equipment, all of Tampa. The company also plans improving 1,000 ft. of water-front property along terminals, erecting warehouse 260 ft. long and docks 740 ft. long.

KNOXVILLE, TENN.—The Roddy-Goodman Co. has awarded contract to BORCHES & WARDREP, Knoxville, for erection of candy factory. It will have three stories and basement, of reinforced concrete with metal frames; fire doors. Cost, $25,000. W. H. Burk, Knoxville, is Arch.

SANDUSKY, OHIO. — The BUCKEYE REALTY & CONSTRUCTION CO., of Sandusky, has secured contract to construct a plant here for the Lake Shore Portland Cement Co. The plant will have a capacity of 3,000 bbls. a day.

YOUNGSTOWN, OHIO.—L. ADAVASIO & CO., has been awarded the contracts for building two additions to the plant of the Republic Rubber Co. The buildings will be of reinforced-concrete construction, one 65 × 240 and the other 30 × 60 ft.

The Block Light Co. has purchased a tract of two acres of land in this city and will erect at once a plant for the manufacture of incandescent mantles and burners for gas. The plant will be of brick, steel and concrete, and will have its own power plant.

EAST LIVERPOOL, OHIO.—G. Davis and H. B. Davis, of this city, have let contract for the establishment of a factory for manufacture of brass and special valves. The factory, with its equipment, will cost $50,000.

CLEVELAND, OHIO.—We are unofficially advised that contract for erection of a 5-story building for the Cleveland Laundry Co. has been let by the Osborn Engineering Co. Osborn Bldg., Cleveland, to the CONCRETE FIREPROOFING CO., 1501 East 89th St., Cleveland.

ANDERSON, IND.—The Frazer Stove Co., Indianapolis, has let general contract to CLIFTON & SON, Peru, Ind., for erecting a 2-story factory building, at Anderson. Cost, $25,000.

INDIANAPOLIS, IND.—The Link Belt Co., chain manufacturers, have bought 20 acres of land in West Indianapolis as a site for a malleable iron plant to cost $200,000. The site is near Oliver and Belmont Aves. and Addison St., and lies west of the power plant of the Chandler-Taylor Co. The site includes parts of what are known as the Warman and Becker properties. There will be two new foundries, each more than 800 ft. long. Building operations will begin, it is reported, this fall.

KANKAKEE, ILL.—GEORGE MOROFF has the contract to build a brick mill building, 60 × 100 ft., at East Kankakee, for the Kellogg Car Co.

CHICAGO, ILL.—Postle & Mahler, Archs., Marquette Bldg., have let mason contract to J. W. SNYDER, 160 Washington St., for a factory building for H. P. Nelson & Co. Cost, $55,000.

DUBUQUE, IOWA.—The Union Electric Co., Dubuque, proposes to increase its car storage capacity by the erection of a concrete or brick building about 50 ft. wide by 280 ft. long. The building will have a fireproof roof supported by steel trusses. Special trackwork has been received for five storage tracks. There will be no increase in the machine shops. Definite construction plans will not be made until about Oct. 1.

FORT WORTH, TEX.—The Chicago, Rock Island & Pacific Ry. Co., J. B. Berry, Ch. Engr., Chicago, Ill., will expend $100,000 in terminal improvements, including erection of roundhouse to accommodate about 60 engines.

SEATTLE, WASH.—Work will be commenced within 30 days on a new factory building for the Automatic Measuring Faucet Mfg. Co. The site for the institution has not been definitely determined. The building plans which have been drawn call for a cement-block structure, covering a ground area 32 × 80 ft. The company is an organization recently incorporated under the laws of the State of Washington with a capital stock of $50,000. A. C. Foohlich is Pres.; C. S. Arne is Secy. and Treas.

OTTAWA, ONT.—The Ottawa Electric R. R. Co. has purchased land on Coburg St. on which to erect car barns.

## CONTRACT PRICES.

[Where * precedes item under Contract Prices the work was advertised in Engineering News.]

*BARGE CANAL.—Albany, N. Y.—Bids were received on Sept 9 by F. C. Stevens, Supt. Public Works, for Contract No. 66, Erie Canal, Section 10, for the improvement of the Erie Canal from the west end of Contract No. 64 to about 600 ft. east of the Lockport Locks. Length, 6.35 miles. Bids in detail were as follows: (A) Engineer's estimate; (B) EMPIRE ENGINEERING CORPORATION, 60 Wall St., New York (awarded contract); (C) E. M. Graves, Cleveland, Ohio:

| | (A) | (B) | (C) |
|---|---|---|---|
| 6.35 miles cofferdams, pumping, bailing and draining | $2,000.00 | $2,000.00 | $2,200.00 |
| Clearing (lump sum) | 1,900.00 | 1,900.00 | 2,000.00 |
| 31,500 cu. yds. grubbing | .30 | .36 | .33 |
| 617,700 cu. yds. excavation | .55 | .497 | .55 |
| 50 M. ft. B. M. sheeting and bracing, per M | 50.00 | 50.00 | 55.00 |
| 283,800 cu. yds. forming embankment, first class | .15 | .18 | .16½ |
| 61,600 cu. yds. forming embankment, second class | .12 | .14 | .132 |
| 17,400 cu. yds. lining | 1.25 | 1.25 | 1.375 |
| 8,800 cu. yds. puddle | 2.00 | 2.00 | 2.20 |
| 18 M. ft. B. M. sawed lumber (yellow pine or Douglas fir), per M | 55.00 | 55.00 | 60.00 |
| 3,830 lin. ft. foundation piles | .30 | .30 | .33 |
| 11,130 cu. yds. second-class concrete | 7.50 | 9.00 | 8.25 |
| 1,420 cu. yds. third-class concrete | 6.50 | 7.80 | 7.15 |
| 550 cu. yds. reinforced concrete | 10.00 | 12.00 | 11.00 |
| 10 cu. yds. first-class masonry bridge coping | 30.00 | 30.00 | 33.00 |
| 53,500 cu. yds. wash wall | 2.50 | 2.50 | 2.75 |
| 580 sq. yds. second-class stone paving | 1.50 | 1.50 | 1.65 |
| 1,400 sq. yds. third-class stone paving | 1.25 | 1.25 | 1.375 |
| 500 cu. yds. third-class riprap | 2.50 | 2.50 | 2.75 |
| 104,600 lbs. c.-i. culvert pipe and specials | .03½ | .03½ | .0385 |
| 683,300 lbs. structural steel | .05 | .05 | .055 |
| 55,600 lbs. metal reinforcement | .04 | .04 | .044 |
| 340 sq. yds. wood pavement, 4 ins. thick | 3.00 | 3.00 | 3.30 |
| 1,200 sq. yds. wood pavement, 3 ins. thick | 2.75 | 2.75 | 3.025 |
| 8,940 lin. ft. wooden fence | .20 | .24 | .22 |
| 30 lin. ft. w.-i. pipe railing | 1.50 | 1.50 | 1.65 |
| 640 lin. ft. lattice railing | 1.50 | 1.50 | 1.65 |
| 3 sluice gates valves (each) | 275.00 | 275.00 | 302.50 |
| 650 lin. ft. drilling bolt holes in masonry | .60 | .60 | .60 |
| For maintaining navigation (lump sum) | 7,500.00 | 8,250.00 | 7,500.00 |
| For maintaining highway traffic (lump sum) | 3,000.00 | 3,000.00 | 3,000.00 |
| Deduct price to be paid to the State of New York for buildings in place which are to be removed by the contractor without expense to the State (lump sum) | 700.00 | 700.00 | 700.00 |
| Deduct price to be paid to the State of New York for existing bridge superstructures in place, which are to be removed by the contractor without expense to the State (lump sum) | 1,000.00 | 1,000.00 | 1,000.00 |
| Total | $751,039 | $750,685 | $791,194 |

## MISCELLANEOUS CONTRACTS.

*(* denotes that this work is advertised in Engineering News.)*

U. S. RECLAMATION SERVICE.—Items regarding irrigation, canal projects, etc., will be found under Water Supply—Irrigation.

RAILWAY TUNNELS.—Germany.—See under Foreign Contracts.

ELECTRIC TRAVELING CRANES.—Germany.—See under Foreign Contracts.

TILE DITCH.—Utica, Neb.—Bids are asked until Sept. 15 by C. G. Hurlburt, Secy. Utica Drainage Dist., for constructing a tile ditch. Estimated cost, $12,319.

WHARF.—Cleveland, Ohio.—Bids are asked by Lieut.-Col. John Millis, Cops Engrs., U. S. A., until 10 a. m., Sept. 28, for constructing a wharf at Cleveland Harbor.

DRAIN.—Muskegon, Mich.—Bids are asked until 9 a. m., Sept. 21, by Frank Robinson, Supt. Drains, Muskegon County, for constructing the Ackerberg Drain.

PIER.—Norfolk, Va.—Contract has been awarded to RICHARDSON & BLUMGARDT, Norfolk, for timber work on the coal pier for the Virginia Ry., at Sewells Point.

LEVEE.—Live Oak, Cal.—LAUGENOR BROS., Live Oak, have contract for building four miles of levee here, at 9¾ cts. a cu. yd. Estimated quantity, 110,000 cu. yds.

GASOLINE ENGINE.—Washington, D. C.—Bids are asked until 2 p. m., Oct. 1, by the U. S. Department of Agriculture, for one 50-HP. gasoline marine engine.

LIGHTING SYSTEM.—New York, N. Y.—Bids are asked until 3 p. m., Sept. 24, for lighting system, etc., for Metropolitan Museum of Art. See under Light and Power Plants.

DITCH.—Decatur, Ill.—The contract for building a ditch in the Long Creek and Oakley district has been let to the INDIANA DRAIN TILE CO., of Brooklyn, Ind., at $11,409.

*GRADING.—York, Pa.—Bids are asked by the York Railway Co. until Sept. 30 for grading 4½ miles of line, amounting to 80,000 cu. yds. L. C. Mayer, York, is Ch. Engr.

DITCHES.—Decatur, Ill.—Bids are asked until 2 p. m., Sept. 26, by the Commissioners of Stevens Creek Special Drainage District, Macon County, for cleaning various ditches in this district.

AIR COMPRESSOR.—Fort Washington, Md.—Bids are asked by H. L. Pettus, Constr. Q. M., U. S. A., until noon, Sept. 30, for the installation of an air compressor at this post.

DITCH.—Smartville, Cal.—GEORGE COSTELLO, Marysville, Cal., has contract for building the Blue Point ditch for the Blue Point mine, near Smartville. It will be 28 miles long.

DIKE WORK.—Evansville, Ind.—Bids will be received until 2 p. m., Sept. 18, by Col. Wm. T. Rossell, Corps Engrs., U. S. A., Cincinnati, Ohio, for repair and bank protection to dikes at Evansville.

WHARF.—New York, N. Y.—Bids are asked until 11 a. m., Sept. 30, by the Constructing Quartermaster, Governor's Island, N. Y. H., for reconstruction and repairs to wharf at Governor's Island.

DRAINAGE.—Limoilou, Que.—Contract for drainage system here has been awarded to JOSEPH GAGNON, of Beauport, Que., at $46,690. Quimet & Lesage, Montreal, Que., are Engrs.

SODDING.—Fort Wood, N. Y.—Bids will be received by Wm. W. Bessell, Constr. Q. M., U. S. A., until Oct. 1 for sodding and repairing terraces at this post (New York, N. Y., post-office).

DITCH.—Webster City, Iowa.—Bids are asked until noon, Sept. 21, by the Board of County Supervisors, for constructing the Jewell tile drainage ditch No. 57. O. A. Cragwick, County Audr.

*EXCAVATION.—Chicago, Ill.—Bids are asked until noon, Sept. 30, by the Sanitary District of Chicago, for excavating a channel, designated as Section 5 of the North Shore Channel, and for certain collateral bridge work. I. J. Bryan is Clerk.

DITCH.—Sioux City, Iowa.—Contract has been let by E. E. Hosmer, County Audr., to FRED M. CRANE, Sioux City, for construction of Wolf Creek ditch. Martin Holmvig, Engr-in-Charge, Sioux City.

*LOCK AND DAM.—Mobile, Ala.—Bids are asked until 11 a. m., Nov. 17, by Maj. H. Jervey, Corps Engrs., U. S. A., for building Dock and Dam No. 16 and lock tender's house, Black Warrior River, Ala.

*DREDGING, EXCAVATION.—Chicago, Ill.—Bids are asked until 10 a. m., Oct. 14, by Col. M. H. Bixby, Corps Engrs., U. S. A., for dredging and rock excavation in Chicago River, Ill. (Erroneously noted as Oct. 4 last week.)

*REMOVING WRECK.—Portland, Me.—Bids are asked by Lieut. Col. Geo. A. Zinn, Corps Engrs., U. S. A., until noon, Oct. 14, for removing wreck of schooner "Annie L. Henderson" in Penobscot River, at Bangor, Maine.

DITCH.—Marshalltown, Iowa.—Bids were received on Sept. 9 by Erastus Cornell, County Audr., for constructing Marshall Drainage Ditch No. 3. Contract was awarded to HENRY FORREY, of Saint Anthony, Iowa, at $2,500.

COAL-HANDLING EQUIPMENT.—Buffalo, N. Y.—Bids will be received until Sept. 24 by Francis G. Ward, Comr. Pub. Wks., for coal and ash-handling equipment in the north boiler-house at the pumping station, Bureau of Water.

CANAL REPAIRS.—Augusta, Ga.—Contract for repairing the Augusta canal was awarded on Sept. 3 to W. J. OLIVER, of Knoxville, Tenn., at 54½ cts. per cu. yd. for replacing 40,000 cu. yds. The work to be completed in 60 days. N. Wingfield, Comr. Pub. Works.

LEVEE.—Sacramento, Cal.—Bids are asked until 8 p. m., Oct. 5, by M. J. Desmond, City Clk., for improving portions of B St. levee and Brighton levee. This is a postponement from Sept. 7. Noted on Sept. 3. Geo. N. Randle, Sacramento, is City Engr. M. J. Desmond, City Clerk.

DAM, DREDGING.—Ottawa, Ont.—Bids are asked until 4 p. m., Sept. 21, by the Department of Public Works, for the construction of a dam across the Montreal River at Latchford, and dredging channel at Port Rapids, District of Nipissing, Ont.

*DREDGING.—Philadelphia, Pa.—Bids were received on Sept. 5 by Maj. Herbert Deakyne, Corps Engrs., U. S. A., Philadelphia, for dredging in Delaware River in Section 1, 3 and 5A. Contract has been awarded to the AMERICAN DREDGING CO., Philadelphia, at $259,784.

REPAIRING SEAWALL.—New York, N. Y.—Bids are asked by the Department of Public Charities until 2.30 p. m., Sept. 22, for furnishing all the labor and materials necessary to raise, straighten and repair seawall, City Hospital, Blackwells Island, New York.

CEMENT, SAND, RIPRAP.—New York, N. Y.—Bids are asked by the Department of Docks and Ferries until noon, Sept. 24, for Contract No. 1,152, for furnishing and delivering cement and sand and for furnishing and delivering and putting in place riprap stone.

*LIGHTHOUSE FOUNDATION.—Wilmington, Del.—Bids were received on Sept. 10 by the Lighthouse Engineer for erecting the foundation for the lighthouse at Miah Maul Shoal Light-Station, Delaware Bay, N. J. The bid of the Sherwood Engineering & Construction Co., York, Pa., at $1,300 has been recommended for award.

EMBANKMENT.—Columbus, Ohio.—Bids were received on Sept. 2 by the Board Public Service for constructing a levee embankment adjacent to the proposed garbage reduction works in Franklin Township, Contract No. 2. Contract has been awarded to JONES BROS., Harrison Bldg., Columbus, at $11,070.

SALE OF STONE.—Cincinnati, Ohio.—Bids are asked by the Board Public Service until noon, Sept. 21, for the stone contained in the walls of the Third St. Reservoir. The bidder shall state the price which he or they will pay per cu. yd. for the stone measured in wall in accordance with specifications.

DITCH.—Mount Carmel, Ill.—Bids are asked by the Drainage Commissioners of District No. 2, Wabash County, until 1 p. m., Sept. 22, for constructing a ditch about 6 4-5 miles in length, containing about 45,852 cu. yds. of excavating. The contractor is to raise and lower all bridges and clear the right-of-way. J. A. Carlton, County Clerk.

TIMBER WHARF.—Port Jefferson, N. Y.—Plans and specifications are in readiness for bids on a timber wharf and pier at Port Jefferson (L. I.), N. Y., for the Dyett Sand-Lime Brick Co., and may be seen at office of Frederick L. Smith, Industrial Engr., 5 Beekman St., New York, where the bids will be received.

BATTLESHIP.—Washington, D. C.—Bids are asked until noon, Nov. 9, by the Navy Department, for constructing by contract one battleship (No. 31). Circular defining the chief characteristics of such vessel, and plans and specifications for her construction are now ready for distribution among prospective bidders. Forms of proposal and contract may be had on application to the Department after Sept. 30. V. H. Metcalf, Secy.

SEAWALL.—Toronto, Ont.—The contract for the construction of the easterly portion of the new seawall from Sunnyside to the Humber has been let to PETER ARNOT, of Toronto, at $41,544. The contract is for the construction of 1,500 ft. of solid concrete wall on timber cribwork, with two landing stages.

LOCK GATES.—Winnipeg, Man.—The Government has awarded contracts for the steel required for the work at St. Andrews locks to the CANADIAN FOUNDRY CO., Ltd., Notre Dame St., Winnipeg, and the CANADIAN GENERAL ELECTRIC CO., 81 St. Peter St., Montreal, Que. The contract price amounts to $600,000. Bids were received on Sept. 14 by the Department of Public Works, Ottawa, Ont.

*STEEL STACK, BOILERS.—Boston, Mass.—Bids are asked until 11 a. m., Oct. 10, by the Bureau Yards and Docks, Navy Dept., Washington, D. C., for furnishing and installing two boilers with stokers, superheaters, and stack at the Navy Yard, Boston, Mass. Specifications are on file at office of Engineering News, New York.

BREAKWATER.—Gary, Ind.—Owing to a typographical error it was stated last week that "the U. S. Steel Corporation has awarded to the GREAT LAKES DREDGING & DOCK CO., of Chicago, Ill., the contract for constructing a breakwater at Bary, about 3,200 ft. in length. Estimated cost, $1,000,000." The items should read "Gary."

DREDGE EQUIPMENT.—New Orleans, La.—Bids will be received until Oct. 5 by Col. E. H. Ruffner, Corps Engrs., U. S. A., for furnishing and installing mechanical device to operate bin valves, furnish and install overflow troughs, and for repairs and alterations of drag hoist davits on U. S. Dredge "Benyaurd."

ROCK REMOVAL.—Boston, Mass.—Bids were received by the Board of Harbor and Land Commissioners at Room 131, State House, Boston, Mass., on Sept. 11, for removing rock from Rockport Harbor, as follows (to extent of $8,000 appropriation): Philip H. Dogen, Portland, Me., $5.75 per ton; Thos. FitzGibbon, Beverly, Mass., $3.98 per ton.

DREDGING.—New Orleans, La.—Bids were received by Lieut. W. Willing, Corps Engrs., U. S. A., on Sept. 8, for dredging about 900,000 cu. yds., in two lots, between Vermillion Bay and Mermentan River, La., in connection with construction of intercostal canal in Louisiana. Bid of John Anderson, Gulfport, Miss., at 7¼ cts. per cu. yd. (for both lots), has been recommended for acceptance.

*CEMENT.—Vicksburg, Miss.—Bids were received on Sept. 8 by Capt. Clarke S. Smith, Corps Engrs., U. S. A., Vicksburg, for furnishing Portland cement for use in construction of Lock and Dam No. 8, Ouachita River, Ark. Contract was awarded to the GLENCOE LIME & CEMENT CO., St. Louis, Mo., for Lehigh cement, at $2.34 in bbls., or $2 in sacks, delivered at Calion, Ark.

*DRAINAGE.—Annawan, Ill.—Bids were received by the Commissioners of the Mud Creek Special Drainage District, Henry County, on Sept. 5 for the renewal of approximately 464,742 cu. yds. of material for construction of ditches in this district. H. E. Reeves, Atkinson, Ill., is Engr. Contract was awarded to G. A. McWILLIAMS, of Walnut, Ill., at 6.1 cts. per cu. yd.

TIMBER SALE.—Ottawa, Ont.—Bids are asked by the Department of Indian Affairs until noon, Sept. 24, for the maple, beech, basswood, birch and hemlock timber, of 9 ins. and upward in diameter at the stump, on Giant's Tomb Island, in the Georgian Bay, situated near the towns of Midland and Penetanguishene, and containing an area of about 1,400 acres. J. D. McLean, Dept. Secy.

DREDGING.—Evansville, Ind.—Bids were received as follows by Col. Wm. T. Rossell, Corps Engrs., U. S. A., Cincinnati, Ohio, on Aug. 31 for dredging harbor at Evansville: The OHIO CONTRACT CO., Evansville, Ind., 20 cts. per cu. yd. (awarded contract); the Monongahela & Western Dredging Co., Pittsburg, Pa., 33 cts. per cu. yd.; Sheridan-Kirk Contract Co., Cincinnati, Ohio, 20½ cts. per cu. yd.

SUBWAY.—Buffalo, N. Y.—The Eastern Concrete Steel Co., 401 Morgan Bldg., Buffalo, was the lowest bidder for the subway and abutment work in connection with the elimination of the grade crossing of the Grand Trunk Railway at Niagara St. and the International Bridge approach. The bids were for two classes of work: Stone, $62,639, and reinforced concrete, $55,936. Contracts will be awarded by the Grand Trunk Ry. Co. in conjunction with the Grade Crossing Commission.

LEVEE CONSTRUCTION.—Velasco, Tex.—Bids are asked by the Board of Drainage Commissioners, Velasco Drainage District of Brazoria County, at office of E. P. Hoefle, Velasco, Tex., until Oct. 3 for construction of levees, spur dikes, ditches, drains and for clearing right-of-way and sodding with Bermuda grass of levee. Ditches will require 62,755 cu. yds. of excavation; levees, 148,956 cu. yds.; total excavation, 211,711 cu. yds. J. C. Tolman, Ch. Engr., at Velasco.

REPAIRING BOATS.—New York, N. Y.—Bids were received as follows on Sept. 10 by the Department of Street Cleaning for furnishing all the labor and materials required to repair the three steam dumpers of the Department of Street Cleaning, known as "Aschenbroedel," "Cenerentola" and "Cinderella": Alexander Miller & Bro., Jersey City, N. J., $34,000; James Trezarthen & Son, Ft. of Seventh St., New York, $22,000; Columbian Engineering Works, Imlay, Brooklyn, N. Y., $18,200.

CONCRETE DAM.—Cincinnati, Ohio.—Bids were received as follows by Col. Wm. T. Rossell, Corps Engrs., U. S. A., Sept. 10 for constructing dam of concrete, etc., at head of Brown Island, Ohio River: Advance Sand & Construction Co., Pittsburg, $44,671 (any approved brand of cement). Pennsylvania Contracting Co., Pittsburg, $49,684 (Edison or other standard brand). The H. C. Talbott Co., Dayton, Ohio, $58,045 (Giant). J. C. Thomas, Louisa, Ky., $49,540 (not specified). Itemized bids will be given next week under Contract Prices.

DRYDOCK.—Buffalo, N. Y.—The American Shipbuilding Co., Cleveland, Ohio, will build a drydock at its Buffalo plant, to be 630 ft. long, 100 ft. wide at the top and 75 ft. at the bottom. It will be built on the site of the present docks Nos. 2 and 3 and will cost $300,000. Plans for the work were prepared by A. V. Powell, Engr., Chamber of Commerce Bldg., Chicago. The company will also lengthen its small dock at Superior, Wis., 100 ft., making it 610 ft. long by 65 ft. wide, at a cost of $100,000. The contract has been let to the BARNETT & RECORD CO., Duluth, Minn.

*DREDGING.—Plymouth, Mass.—Bids were received as follows by the Board of Harbor and Land Commissioners at Boston on Sept. 4 for dredging channel in Plymouth harbor, from Cow Yard to wharf of Plymouth Cordage Co.; estimated quantities: (A) for dredging 700,000 cu. yds. sand and clay; (B) eight oak pile dolphins. Contract has been awarded to EASTERN DREDGING CO., 247 Atlantic Ave., Boston, at 16.7 cts. per cu. yd. for dredging and $120 each for dolphins. Maritime Dredging Co., 78 Broad St., New York, (A) 17.65 cts.; (B) $100. John B. Astell & Co., 293 Marginal St., East Boston, (A) 21⅝ cts.; (B) $100. Coastwise Dredging Co., Norfolk, Va., (A) 22.9 cts.; (B) $97.

LEVEE.—New Orleans, La.—Contracts have been awarded to REYNOLDS & CO., New Orleans, by Board of Commissioners, Orleans Levee District, New Orleans, for construction of following work: Third District—Levee and revetment, from Louisa to Desire St., about 45,000 cu. yds. of earth and about 36,000 ft. B. M. creosoted lumber, at 90 cts. a cu. yd; lumber, $70. Levee and revetment, from Mazant to Poland St.; about 70,000 cu. yds. of earth and about 55,000 ft. B. M. creosoted lumber, 90 cts.; $70. Fourth District—Levee, from Jackson Ave. to Third St.; about 30,000 cu. yds. of earth, 90 cts. Levee, from Seventh St. to Louisiana Ave.; about 100,000 cu. yds. of earth, 90 cts. Total, $226,870. Jules C. Koenig, Pres.; Peter E. Munts, Secy.

TOWBOAT.—Cincinnati, Ohio.—Bids were received by Lieut-Col. J. G. Warren, Corps Engrs., U. S. A., on Sept. 9, for building a wooden hull towboat with snagging appliances. Bids were as follows: (A) Howard Shipyards Co., Jeffersonville, Ind.; (B) J. M. Hammitt, Marietta, Ohio: If of new machinery and equipment throughout, (A) $30,000; If of certain parts of machinery taken from U. S. Steamer "General O. M. Poe," (A) $24,600, (B) $32,575; bidder proposes to purchase U. S. Steamer "General O. M. Poe," exclusive of furniture and furnishing, for the sum of: (A) $1,000; (B) $400; number of days from date of approval of contract in which the bidder proposes to make delivery of boat at Frankfort, Ky., (A) 150, (B) 150.

*LEVEE.—Greenville, Miss.—Bids were received on Sept. 7 by the Board of Mississippi Levee Commissioners for various sections of levee. Contracts were awarded as follows: ROACH & STANSELL, Scimitar Bldg., Memphis, Tenn., Sta. 500-600—enlargement, 95,000 cu. yds., at 28 cts. a cu. yd.; Sta. 1000-1038—enlargement, 53,000 cu. yds., at 28 cts.; Sta. 2670-2785—enlargement, 90,000 cu. yds., at 26 cts.; Sta. 3547-3563—extension and enlargement, 80,000 cu. yds., at 28 cts.; Sta. 4894-4962—enlargement, 94,000 cu. yds., at 29 cts.; Sta. 5000 to 5160—enlargement, 172,000 cu. yds., at 24 cts. To MORRISON BROS., Lake Providence, La., Sta. 3250-3311—new banquette, 37,000 cu. yds., at 16.9 cts. To R. L. LEONARD & CO., care Jones & Rogers, Memphis, Tenn., Sta. 3100-3224—enlargement, 80,000 cu. yds., at 29.9 cts.; Sta. 198-224—enlargement, 35,000 cu. yds., at 23.5 cts.; Sta. 4383-4410—enlargement, 36,000 cu. yds., at 18.9 cts.; Sta. 4962-5000—enlargements, 60,000 cu. yds., at 24.4 cts. To GEO. B. VAUGHAN & SON, Citizens' Bank, Greenville, Miss.: Sta. 862-900—enlargement, 42,000 cu. yds., at 21.98 cts.; Sta. 224-256—new levee, 80,000 cu. yds., at 14.94 cts.; Sta. 255-300—enlargement, 46,000 cu. yds., at 15.74 cts.; Sta. 4011-4032—new levee, 90,000 cu. yds., at 16.88 cts. C. H. West, Ch. Engr.; Robt. Somerville, Asst. Ch. Engr., Greenville.

## U. S. POSSESSIONS AND CUBA.

DREDGING.—Hawaii.—Bids are asked until 11 a. m., Dec. 1, by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for dredging a channel to the naval station, Pearl Harbor, Hawaii. Specifications are on file at office of Engineering News, New York.

LUMBER, RAILS, ETC.—Panama.—Bids will be received at office of General Purchasing Officer, Isthmian Canal Commission, Washington, D. C., until 10.30 a. m., Oct. 5, for furnishing lumber, ties, piles, steel rails, angle bars, pumps, chain blocks, repair parts for steam shovels, dredges, drill, iron, etc.

CRANES.—Panama.—Bids are asked until 10.30 a. m., Oct. 7, by Capt. F. C. Boggs, Corps Engrs., U.S. A., General Purchasing Office, Isthmian Canal Comn., Washington, D. C., for furnishing four berm and four chamber cranes, as per Circular No. 467.

DERRICKS, RAILWAY SUPPLIES, ETC.—Panama.—Bids are asked until 10.30 a. m., Oct. 12, by the Isthmian Canal Commission, Washington, D. C., for guy derricks and hoisting engines, steam hammer, shop machines, pneumatic tools, generator and engine, electrical supplies, wire, range boilers, car wheels and axles, frogs, switch stands, tie plates, angle bars, rail braces, track spikes, push cars, jacks, track, drills, wrecking frogs, rail benders, claw bars, lining bars, chisels, hammers, scythes, cant hooks, tongs, wrenches, vises, portable forge, padlocks, iron pipe, ells, brass siphons, valves, water gauges, steam whistles, dynamite, track torpedoes, etc. Capt. F. C. Boggs, Corps Engrs., U. S. A., Gen. Pur. Officer.

BOILERS, HOSE, ETC.—Panama.—Bids are asked until 10.30 a. m., Sept. 24, by Capt. F. G. Boggs, Corps Engrs., U. S. A., Gen. Pur. Agent, Isthmian Canal Comn., Washington, D. C., for furnishing hose, trolleys and bridge drives, marine boilers, wire screening, steel anchors, leather belting, tackle and snatch blocks, canteens, buckets, saw blades, roofing cement, etc., per Circular No. 464.

## FOREIGN CONTRACTS.

(To insure prompt attention, letters upon consular business should be addressed to the American Consult at ———, ———. Such letters are opened and attended to by the person that may be in charge of the office. If addressed to the consul, personally, letters are forwarded to him, unopened, should he be absent, and a delay thus intervenes. If, in the meantime, he should have gone out of office, the matter may wholly escape attention.)

ELECTRIC TRAVELING CRANES.—Germany.—Bids are asked until noon, Sept. 25, by the "Finanzdeputation," Hamburg, for supplying eleven electric traveling cranes.

RAILWAY, TELEGRAPH SYSTEM.—Brazil.—Bids are asked at the Directoria Geral de Obrase Viacão, Rio de Janeiro, until noon, Oct. 14, by the Oeste de Minas Railway for: (1) the supply of vignole rails of 30 and 25 kilogs. per meter, accessories and crossings, iron construction work for bridges from 10 to 80 meters long, telegraph wire of 4 mm. diameter, barbed wire for fencing, and insulators; (2) the construction of sections of the Oeste de Minas Railway (a) from kilom. 48 of the Goyaz Railway to Alberto Isaacson in Oeste de Minas, (b) from Alberto Isaacson to Bello Horizonte, and (c) from S. Vicente Ferrer to Bomjardim, including (in addition to the construction of the permanent way) the erection of buildings and offices and the installation of telegraph line, machinery, motors, turntables, etc. A guarantee of 3,000 milreis (about $1,600), to be increased by the successful competitor to 15,000 milreis (about $8,000), will be required in the case of bids for the first of the above contracts, and one of 5,000 milreis (about $2,700), to be increased by the successful competitor to 20,000 milreis (about $10,800), in the case of bids for the second.

RAILWAY TUNNELS.—Germany.—Bids are asked until 11 a. m., Sept. 30, at the Bauabteilung Schlüchtern at Frankfort-on-Maine (Hedderichstrasse, 59), for the construction of a tunnel (for two lines of railway) of a length of 3,560 meters, on the Frankfort-Bebra line. Bidding sheet, etc., may be obtained at the Chancellery of the State Railway Administration, 67-69, Hedderichstrasse, Frankfort, at a cost of 2 marks (not in stamps). The plans and other documents may be consulted at No. 90 I Schweizerstrasse, Frankfort, and at the Bauabteilung, 20 I Dreibrüderstrasse, Schlüchtern.

Bids will be received at the same time, at the Königliche Eisenbahnbauabteilung, Marschiertorbahnhof, Aix-la-Chapelle, for the construction of a tunnel (for two lines of railway) of a length of about 2,117 meters, on the Aix-la-Chapelle-Hergenrath line. The conditions and plans may be obtained at the above-mentioned Eisenbahnbauabteilung at a cost of 50 marks (not in stamps).

**For other Proposal Advertisements see pages 47, 48, 49, 50, 52, of Advertisements and Construction News page 106.**

## EXCAVATION AND BRIDGE ERECTION.

Sanitary District of Chicago.

Sealed proposals for excavating a channel, designated as Section 5 of the North Shore Channel, and for certain collateral bridge work, will be received by the Clerk of the Sanitary District, at Room 1500, American Trust Building, Chicago, Ill., until 12 M., Standard Time, on Wednesday, September 30, 1908, and will be publicly opened by the Board of Trustees at a meeting to be held on that day.

The work includes the excavation of one-half mile of canal, or about 217,000 cubic yards of earth, and the concrete foundations and erection only of the Denpster Street bridge, situated in Sections 23 and 14, R. 41, R. 13, in the Township of Niles, Cook County, Ill.

All proposals must be made upon blank forms furnished by the Sanitary District and in accordance with the plans, specifications and contract form on file in the office of Chief Engineer of the Sanitary District, Room 1500, American Trust Building, Chicago, Ill.

Bidders must submit, with their proposal, a statement of the plant and equipment owned by them and available for immediate use on the proposed work. No bid will be accepted unless the party making it shall furnish evidence satisfactory to the Board of Trustees, of his experience and financial ability to successfully prosecute the proposed work to completion within the specified time.

Each bid must be accompanied by a certified check or cash to the amount of three thousand ($3,000.00) dollars. All certified checks must be drawn on some responsible bank doing business in the City of Chicago and made payable to the order of the Clerk of the Sanitary District.

The said Board of Trustees reserves the right to reject any and all bids

The Sanitary District of Chicago,
By ROBERT R. McCORMICK,
President of Its Board of Trustees.
Attest:
I. J. BRYAN,
Clerk.
Chicago, September 9, 1908.

## ILLINOIS RIVER BRIDGE.

NOTICE OF PUBLIC LETTING.

City of Ottawa, La Salle Co., Ill.

Notice is hereby given that sealed proposals for the work to be hereinafter described in the specifications will be received by the Mayor and City Council at the City Hall, Ottawa, La Salle County, Illinois, until seven o'clock P. M., October 6, 1908, at which place and hour the bids will be publicly opened and read. The bids will be compared on the basis of the Engineer's estimate on the materials and work to be done, which includes the following items:

Item A. Substructure work.
Item B. Superstructure work.

Separate bids must be made for each item, which will be considered separately.

GENERAL DESCRIPTION.

Item A includes the removal of the present superstructure, the capping and extending of three of the existing piers, rebuilding one pier from the water line and building one new pier. The present piers are stone masonry. Concrete is to be used for the repairs and new work.

Item B. The work on the superstructure is to include the furnishing of all materials and work necessary for the erection complete of four pin-connected steel spans, 153 feet, pin centers; one pin-connected steel span 187 feet, pin centers, and one riveted bascule span approximately 117 feet in length.

The width of clear roadway to be, between trusses, 24 feet. On the east side of the east truss is to be constructed a 6-foot sidewalk. A single track is to be provided for street railway cars. The floor on all spans, except the bascule span, is to be 4-inch creosoted plank with brick laid thereon with a 1-inch sand cushion. The bascule span is to be provided with Schuman pavement. The sidewalks on all except the bascule span are to be built of reinforced concrete. On the bascule span the sidewalk is to be 2-inch maple plank.

MAILED BIDS.

Proposals may be sent by mail, addressed as follows:

"Proposals for Illinois River Bridge at Ottawa, Illinois. City Clerk, Ottawa, Illinois.

The Mayor and City Council reserve the right to reject any or all bids. Each bid must contain the full name of the person or company interested in same and be accompanied by a bond or a certified check, satisfactory to the Mayor and City Council, in the sum of $2,500 as a guarantee that if the bid is accepted a contract will be entered into. Should any bid be rejected, such check will be forthwith returned to the bidder. Should any bid be accepted, such check will be returned upon proper execution of the contract and filing of the required bond, otherwise, it is to be accounted the property of the City of Ottawa. The bids must be made on the printed forms, which, together with the plans and specifications, may be had upon application to the office of the State Highway Engineer, Springfield, Illinois. A charge of $1.00 will be made for a set of plans.

## STANDPIPE ROOF.

Wrentham, Mass.

The Board of Water Commissioners of Wrentham, Mass., will receive bids for construction of roof to standpipe (which is 30 ft. diameter and 50 ft. wide), constructed of wood or metal, with necessary openings and ventilation, pitch to be not over 20%. Bidder to furnish all tools and appliances, and to furnish specification with bid. Right reserved to reject any bid. Bids should be addressed to E. F. McCLENNEN, Secretary, and marked "Bid," and will be opened at Town Offices at 8 p. m., Oct. 1st, 1908.

## SEWAGE DISPOSAL WORKS.

OFFICE OF THE SEWERAGE COMMISSION OF THE CITY OF BALTIMORE.

Sealed proposals, indorsed "Proposal for Constructing the Sewage Disposal Works, Sanitary Contract No. 30"; "Proposal for Building West Low Level Interceptor, Section 4, Sanitary Contract No. 31"; "Proposal for Building Force Main Sewer, Sanitary Contract No. 32"; "Proposal for Building Force Main, Sanitary Contract No. 33"; addressed to the Board of Awards of Baltimore City, will be received at the office of Mr. J. Sewell Thomas, City Register, City Hall, Baltimore, Md., until 11 A. M., Wednesday, October 14th, 1908, for constructing the Sewage Disposal Works, on the west shore of Back River, Baltimore County, Md.; the West Low Level Interceptor, Section 4; the Force Main Sewer, and the Force Main, as shown on plans on file in the office of Mr. Calvin W. Hendrick, Chief Engineer of the Sewerage Commission.

Specifications and plans can be obtained upon application at the office of the Sewerage Commission, Room 904 American Building, Baltimore, Md., on and after Saturday, September 26th, 1908. The following charges will be made for each specification with blueprints:

| | |
|---|---|
| Sewage Disposal Works, Sanitary Contract No. 30 | $15.00 |
| West Low Level Interceptor, Sanitary Contract No. 31 | 5.00 |
| Force Main Sewer, Sanitary Contract No. 32 | 5.00 |
| Force Main, Sanitary Contract No. 33 | 5.00 |

These charges will be refunded upon return of the unused specifications and plans in good condition.

A certified check of the bidder, for the respective amounts shown below, on a Clearing-house Bank, made payable to the order of the Mayor and City Council of Baltimore, will be required to be deposited with each bid:

| | Amount of Check. |
|---|---|
| Sewage Disposal Works, Sanitary Contract No. 30 | $20,000 |
| West Low Level Interceptor, Sanitary Contract No. 31 | 5,100 |
| Force Main Sewer, Sanitary Contract No. 32 | 5,500 |
| Force Main, Sanitary Contract No. 33 | 4,800 |

APPROXIMATE QUANTITIES.

Sewage Disposal Works, Sanitary Contract No. 30.

31,000 cu. yds. Excavation.
9,800 cu. yds. Backfilling.
3,500 cu. yds. Rolled Embankment.
2,925 lin. ft. Vitrified Pipe Drains.
9,600 lin. ft. Vitrified Pipe Underdrains.
34,930 lin. ft. Vitrified Pipe Lateral Distributors.
521,500 lin. ft. Slotted Vitrified Tile Slabs.
38,800 cu. yds. Concrete Masonry.
1,300,000 pounds Reinforcing Rods.
350,000 sq. ft. Reinforcing Wire Fabric.
381 tons Cast-Iron Pipe and Special Castings.
2,300 lin. ft. Vitrified Tile Electric Conduit.
1,150 lin. ft. Lined Metal Electric Wire Conduit.
320 Flushing Hydrants.
5 Venturi Meters.
114 Sluice Gates.
1 Meter House.
1 Control House.
4 Pump Houses.

West Low Level Interceptor, Sanitary Contract No. 31.

2,248 lin. ft. 60" diameter Brick and Concrete Sewer.
2,041 lin. ft. 51" diameter Brick and Concrete Sewer.
700 cu. yds. Brick Masonry.
3,220 cu. yds. Concrete Masonry.
21,500 pounds Reinforcing Steel.
4,500 lin. ft. Underdrains.
805,000 feet Sheeting left in place.
16,000 lin. ft. Piles.
3,550 sq. yds. Waterproofing.
2,000 lin. ft. House-connections.
2 Bellmouths.

Force Main Sewer, Sanitary Contract No. 32.

4,500 lin. ft. 99" diameter Brick and Concrete Sewer.
775 cu. yds. Brick Masonry.
8,138 cu. yds. Concrete Masonry.
35,000 pounds Reinforcing Material.
2,000 lin. ft. Underdrains.
250,000 feet Sheeting left in place.
12,000 pounds Cast Iron.
4,000 lin. ft. House-connections.

Force Main, Sanitary Contract No. 33.

5,221 lin. ft. 42-inch Double Line Cast Iron Force Main.
6,690 lin. ft. Class "A" Pipe.
3,534 lin. ft. Class "B" Pipe.
62 tons Special Castings.
225,000 feet Sheeting left in place.
4 42-inch Single Face Gate Valves.

The successful bidder on each contract will be required to give bond and comply with the City Charter respecting contracts.

The Board of Awards reserves the right to reject any and all bids.

By order of the Sewerage Commission:

PETER LEARY, Jr.,
Chairman.
HARRY W. RODGERS,
Secretary.

Approved:
J. BARRY MAHOOL,
President, Board of Awards.

## WATER-WORKS.

Verona, N. J.

Sealed proposals for furnishing Material and Constructing a System of Water-Works for the Incorporated Borough of Verona, Essex County, New Jersey, will be received at the Council Room, Bloomfield Avenue, Verona, N. J., by the undersigned until 8 o'clock P. M., October 28th, 1908, then publicly opened.

Work will embrace furnishing approximately 1,000 tons Cast Iron Pipe, 20 tons Special Castings, 87 Fire Hydrants and 152 Valves, and 9 miles Pipe Laying.

Specifications will be on file and may be obtained from the engineer's branch office, or office of David H. Slayback, Verona, N. J.

Plans will be on file and may be seen at the branch office of the engineer or at the office of David H. Slayback.

The right is reserved to reject any or all bids, or accept any bid, or bids, that may prove advantageous to the said Borough.

Committee on Water Supply,
WILLIAM A. SMITH, Chairman.
D. H. SLAYBACK.
ROLAND A. JACOBUS.

Engineer,
WALTER E. SEXTON,
46 North Twelfth St.,
Philadelphia, Pa.
Branch Office, Mineola, N. Y.

## WATER-WORKS.

Haddonfield, N. J.

Sealed proposals, addressed to J. J. Morris Roberts, Mayor, will be received by the Borough Council, Haddonfield, N. J., until 8 o'clock P. M., October 6th, 1908, for furnishing all the material and performing all the labor required in the construction of a Municipal Water-Works.

The work includes:

About eleven miles of cast-iron and other approved pipe; also Special Castings, Valves and Fire Hydrants.
Power-House and Foundations.
Stand Pipe, 25 ft. diam. by 110 ft. high.
Laying all pipe lines.
Two one-million-gallon pumping units, Steam, Gas Producer or Gasoline.
And two or more artesian wells.

Bids for the whole work must be accompanied by a certified check of five thousand ($5,000) dollars, made payable to the Borough Treasurer.

All bids must be made on blank forms. Blank forms and specifications may be obtained from the Borough Clerk, and the Plans may be seen at the Borough Hall, or at the office of the Engineer, George Pfeiffer, Jr., 27 Market St., Camden, N. J.

The right is reserved to accept any bid or reject any or all bids.

(Signed) ALLEN CLYMER,
Borough Clerk.

Dated Sept. 11, 1908.

## GRADING.

York, Pa.

Bids will be received at the Engineer's Office of the York Railways Company, York, Pa., for the grading of four and one-half (4½) miles of road, amounting to eighty thousand (80,000) yards. Bids will be opened Wednesday, September 30th.

## Situations Open

STRUCTURAL DRAFTSMEN WANTED.—Should have at least two or three years' experience on building work. Apply at once, giving age, experience and salary expected. SAMPLE & MARSHALL CO., 1321 G St., N. W., Washington, D. C. 12-1t

WANTED—Immediately, for about two months work, a technical graduate with experience as inspector of vitrified brick pavement; eight hour day; pay for overtime. Salary $75 to $100 per month. Applicant must state whether he is willing to work on night shift; also describe experience and education and give references. Apply "A. A. 12," Engineering News, New York. 12-1t

FOREMAN—Two thoroughly capable and experienced at once on false work for concrete bridges and on operation of contractors' machinery. Full reply, wages and definite assurance required in first letter. BARTLETT & KLING, Waterloo, Iowa. 12-1t

SALESMAN.—A traveling salesman who is now selling the machine hardware or railroad supply trade, to carry a high grade bearing metal (Babbitt) as a side line, on liberal commission basis. Address, with full particulars, LAKEWOOD METAL CO., Box 182, Lakewood, N. J. 12-8t

## Miscellaneous Wants

WANTED TO RENT

One Steam Shovel, 1½ yds.
One Steam Shovel, 2 yds.
One Spreader Car.
Fifty 4 or 5 yd. standard gage, two way Dump Cars.
Twenty track miles of 35 or 40 lb. Rail.
Address "X. A. 12," Engineering News, New York. 12-1t

## FOR SALE

FOR SALE

**Sand, Lime, Brick Plant**

Capacity 20,000; complete with 125-HP. Engine, 150-HP. Boiler, Tube Mill Hardening Cylinder and 4 Mold Boyd Press. All in good order. Will sell complete or will sell machinery separate. For terms and description address
BLUE RIDGE GRANITE BRICK CO.,
12-4t Asheville, N. C.

300 to 400 Tons of Light, first class and new,

**STEEL RAILS**

12-45 lbs. rolled from billets; can be sold from stock at exceptionally low figures. Address "Z. A. 12," Engineering News, New York. 12-4t